

Trouble-shooting instructions : OPE-5013
BOSCH system : ABS
Make of vehicle : OPEL OMEGA/SENATOR-B
Basic microcard : PKW - 063

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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following models:

* Opel Omega 1.8 , 1.8 S , 2.0 , 2.3 ,
2.3 TD , 3.0 —> 10.86

ABS with 4 wheel-speed sensors and 3 hydraulic channels.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- *For reasons of safety, the hydraulic modulator must not be repaired, but may be exchanged only as a complete unit.
Exception: relays
- *Do not loosen any screws on the hydraulic modulator! Danger of fatal accident owing to failure of the brakes.
- *Take great care when handling brake fluid.
Poison!

For further information, see brief instructions.

TEST REQUIREMENTS FOR TESTING WITH ABS2 LED TESTER

- * Regulatory tire size fitted?
- * Check for firm seating of ground of return-supply pump.
- * Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- * Check for firm seating of ground strap between engine block and vehicle frame.
- * Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).
- * If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).
- * If the ABS warning lamp lights up constantly and does not go out, check the following points:
 - Controller plug sitting correctly on controller and latched?
 - All plug contacts O.K.?
 - Spring contacts latched?
 - Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

Wheel-speed sensors:

front left to term. 6 and term. 4.
front right to term. 11 and term. 21.
rear left to term. 8 and term. 9.
rear right to term. 24 and term. 26.
rear axle to term. - and term. -.

- V-belt snapped?
(Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).
- * Connect ABS 2 LED tester to ABS wiring harness.
- Disconnect and connect controller only with ignition switched off.
- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- Observe LED (green) for current supply in all program-selector-switch positions.

C A U T I O N !

Do not drive with tester connected!

The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.

Repeat the complete test program after any repairs are carried out.

The Antiskid System is a vehicle safety system.

Work on the system demands detailed knowledge of the system.

The conventional brake system must be O.K.

General information for trouble-shooting:

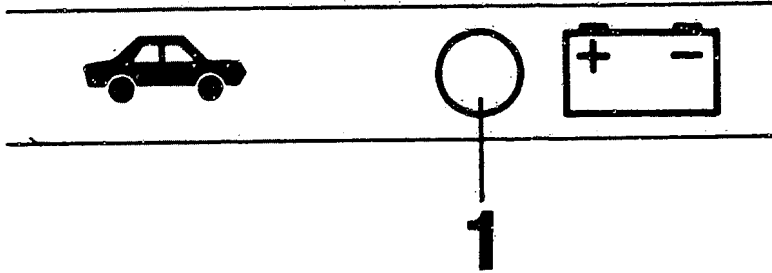
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

Do not drive with tester connected. Are all test conditions met?

Program-switch positions 1 to 6

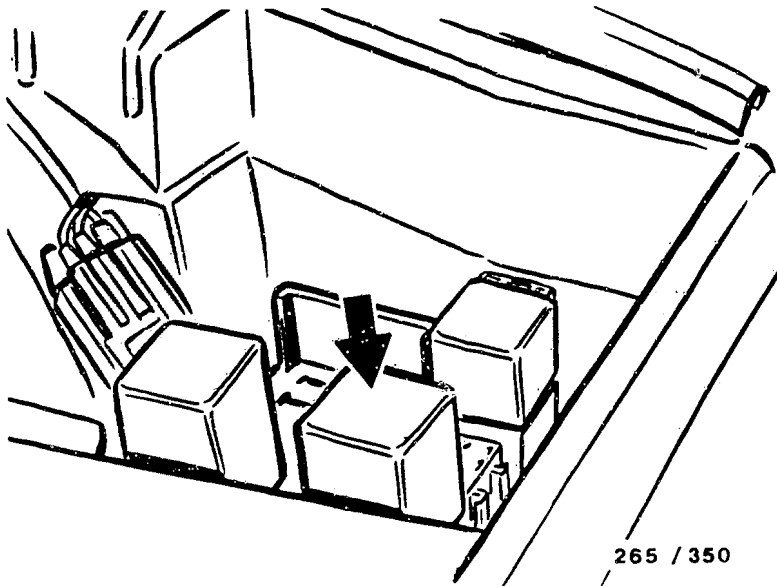
Testing of (measurement at terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of faults
Power supply (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	<ul style="list-style-type: none">*Battery insufficiently charged*High voltage drops*Overvoltage-protection relay defective*Check lead to ignition and starting switch, term. 15



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1 = LED for supply voltage

Arrow = Overvoltage-protection relay

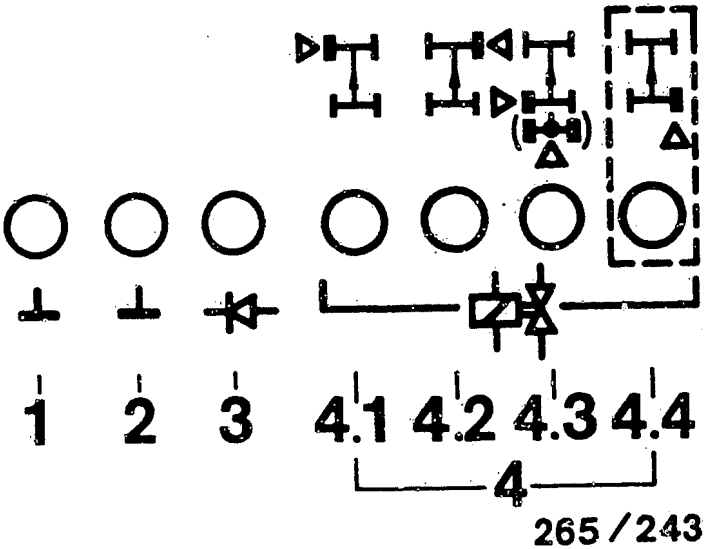


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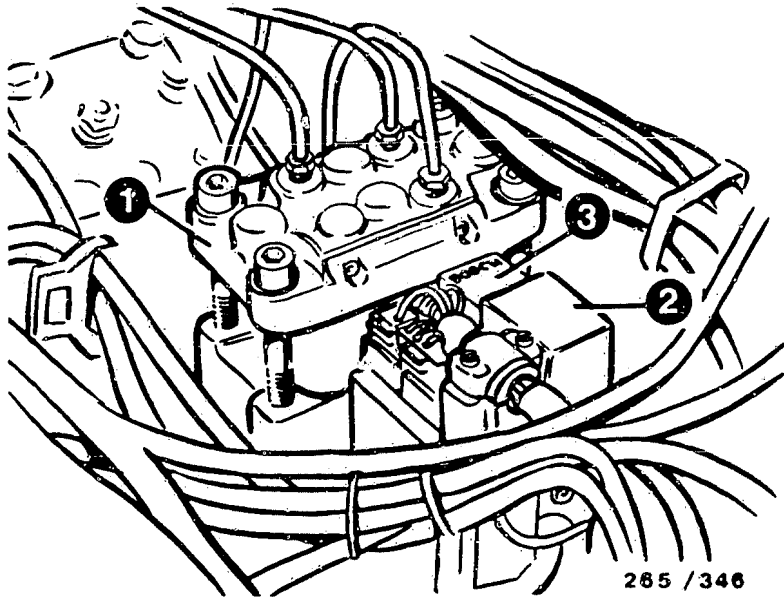
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35) Off-position and ground connection of relay ABS warning lamp	Ignition on	6 LED (1 to 4.3) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.Solenoid-operated valve internal resistance 0,7...1,7 Ω* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.



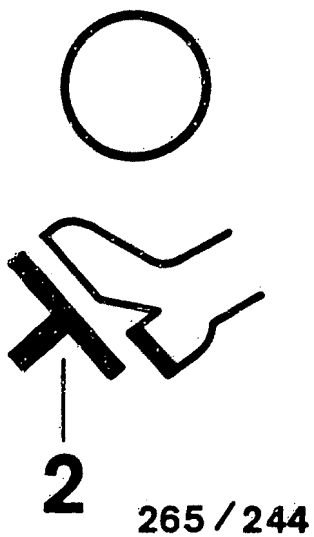
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



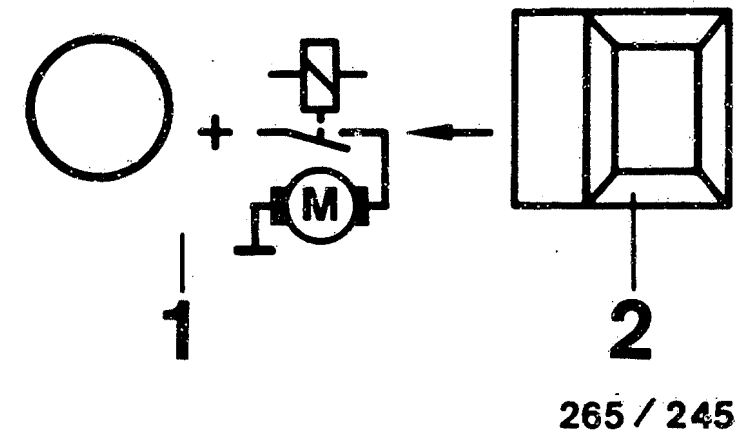
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RAPID DIAGNOSIS CHART (CONTINUED)

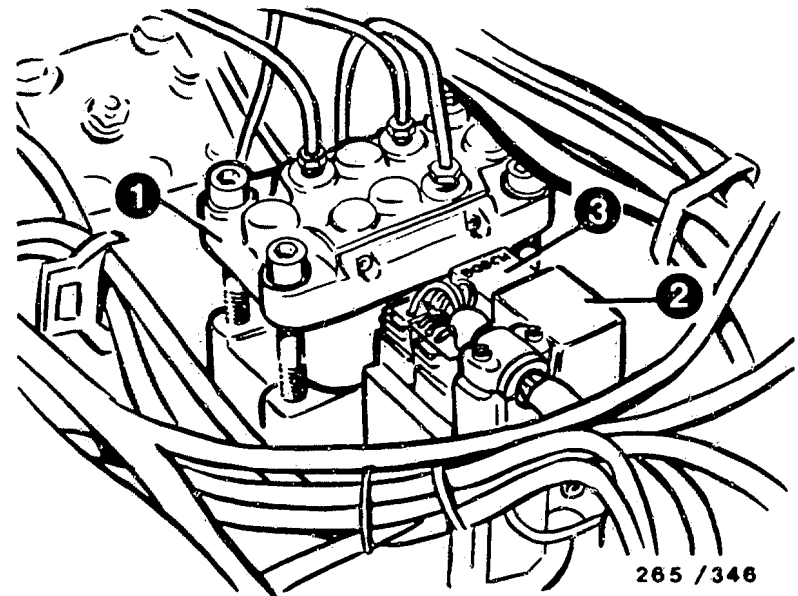
Program-selector-switch position 3

Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, constantly press push- button 2 (upper ill- ustration)	LED 1 lights up, pump motor runs. After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	<ul style="list-style-type: none">* Motor relay defective* Check frame connection and positive terminal of pump motor* Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive lead to hydraulic modulator term. 2.* Pump motor or hydraulic modulator defective.

Program-selector-switch position 4 not applicable.



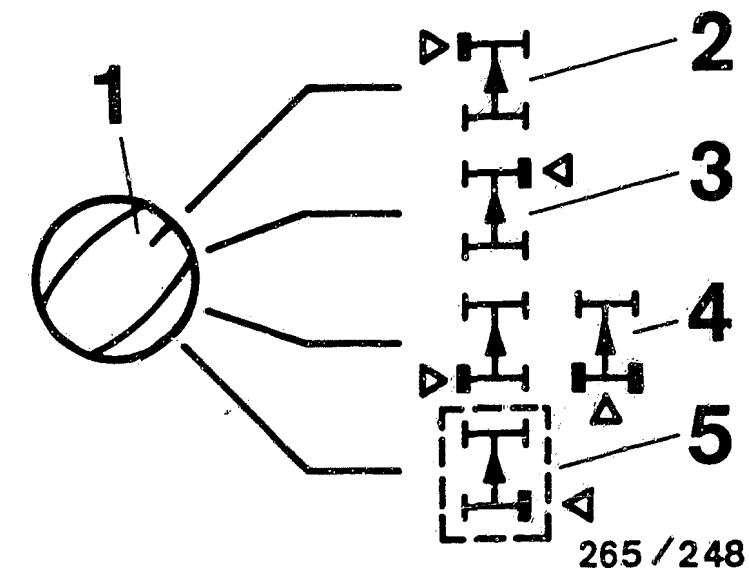
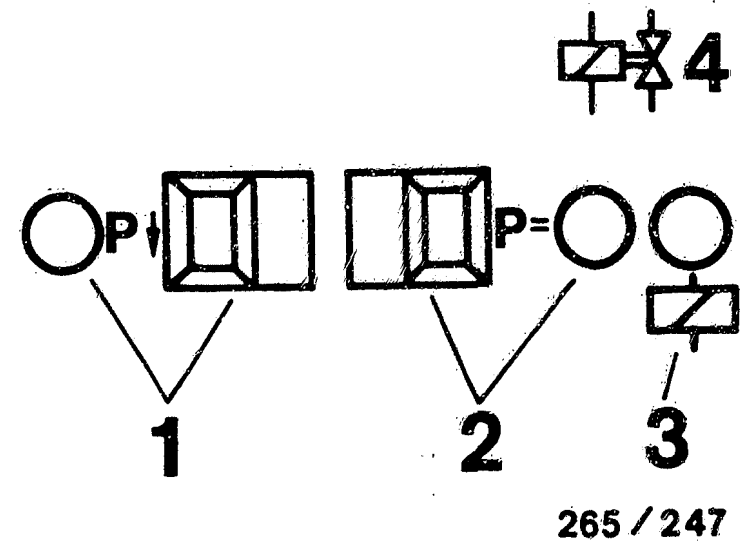
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 5 (3-channel hydraulic modulator)

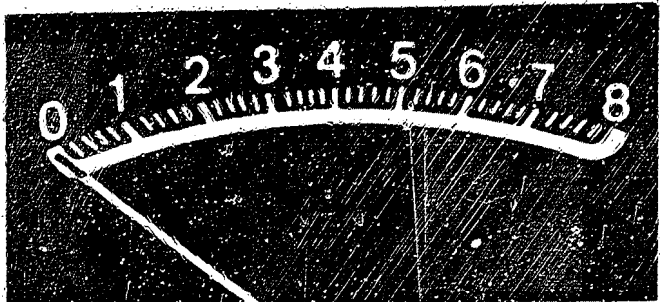
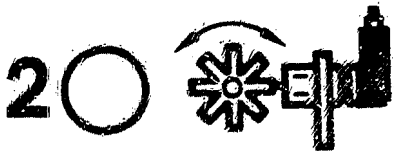
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay operation (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running * Valve relay (make contact) defective * Break in line from valve relay term. 87 to batt. +ve * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push-button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push-button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push-button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correctly connected electrically? Wheel, front left: term. 2 Wheel, front right: term.35 Wheel, rear left: term.- Wheel, rear right: term.- Rear axle: term.18 * Hydraulic modulator defective
	5.Release push-button P arrow (upper illustration)	LED P arrow (upper illustration) goes out, wheel locks	
	6.Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

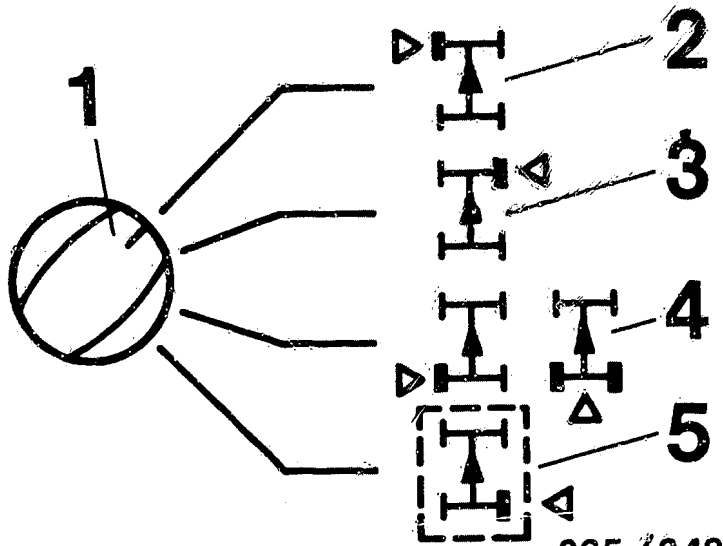
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
<p>Wheel-speed sensor for operation and mix-up</p> <p>NOTE: Check each wheel separately in turn.</p> <p>Wheel, front left: term.6 and term.0,6...1,6 Wheel, front right: term.11 and term.21 Wheel, rear left: term.8 and term.9 Wheel, rear right: term.24 and term.26)</p>	<p>Chock up vehicle. Ignition on.</p> <p>The wheel being tested must be freely turnable by hand.</p> <p>When testing the driven axle, the wheel not being tested must be locked.</p> <p>Set switch for wheel selection to wheel to be tested (lower illustration)</p> <p>Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)</p>	<p>1.Smallest reading larger 1,6 divisions</p> <p>2.Permissible fluctu- ation max. 25 % of largest reading.</p>	<p>*Wheel-speed-sensor lead mixed up</p> <p>*Break in wheel-speed- sensor lead</p> <p>*Wheel-speed sensor defective Winding resistance Front axle: 0,6...1,6 k Ω Rear axle: 4 k Ω</p> <p>*Air gap between wheel-speed sensor and ring gear too wide</p> <p>*Ring gear defective or loose</p> <p>*Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth</p> <p>*Wheel-bearing clearance too large</p> <p>*Reading appears, LED 2 does not light up: loose contact in wheel- speed-sensor lead.</p>



1

+

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Continue test with next coordinate.

TEST SPECIFICATIONS

Wheel-speed sensor

- * Winding resistance at ambient temperature (-10°C...+120°C) for front axle: 600...1600 Ω
- rear axle: 600...1600 Ω

Hydraulic modulator solenoid-operated valves

- * Winding resistance at ambient temperature (-10°C...+120°C): 0,7...1,7 Ω

- Air gap: wheel-speed sensors, front 0,2...1,2 mm
- wheel-speed sensors, rear 0,5...1,5 mm

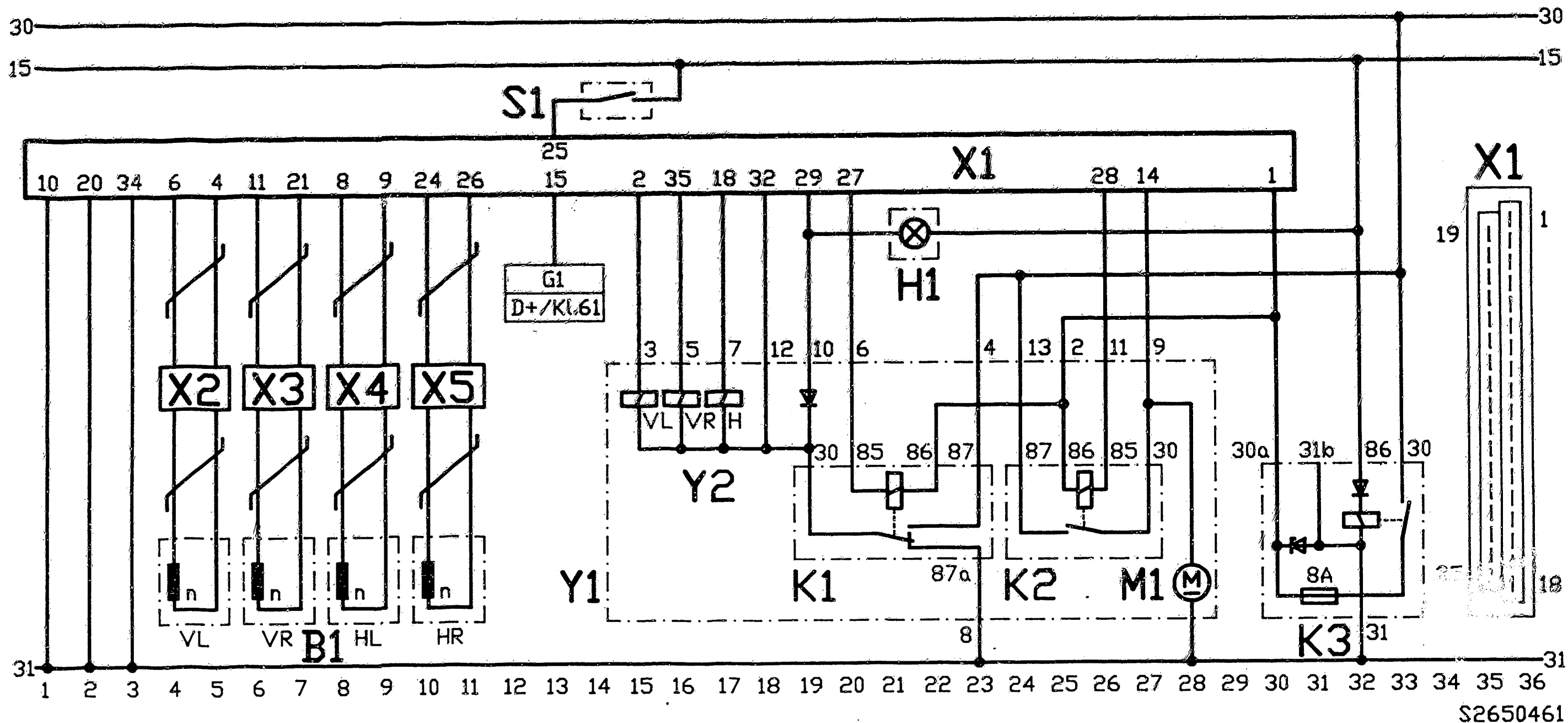
Tightening torque for

- * Fastening screws of the wheel-speed sensors: > 8 Nm
- * Brake-line connections on the hydraulic modulator: 12...16 Nm

Number of teeth

- * Front axle: 48 teeth
- * Rear axle: 48 teeth

For production reasons:
continued on the following
coordinate.



B1 = Wheel-speed sensor
 G1 = to alternator
 H1 = ABS warning lamp
 K1 = Valve relay
 K2 = Motor relay
 K3 = Over-voltage protection relay

M1 = Return-pump motor
 S1 = Stop-lamp switch
 X1 = Controller plug (35-pole)
 X2...X5 = Multiple butt connector
 Y1 = Hydraulic modulator
 Y2 = Solenoid valves

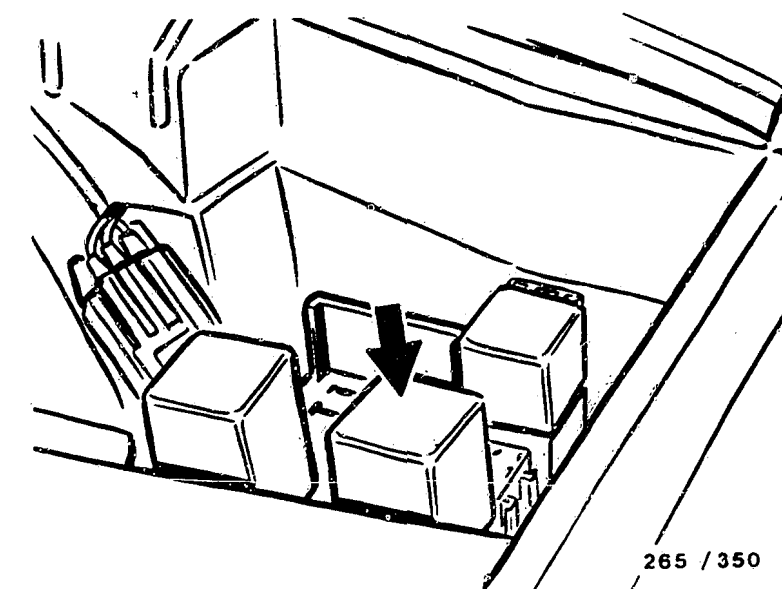
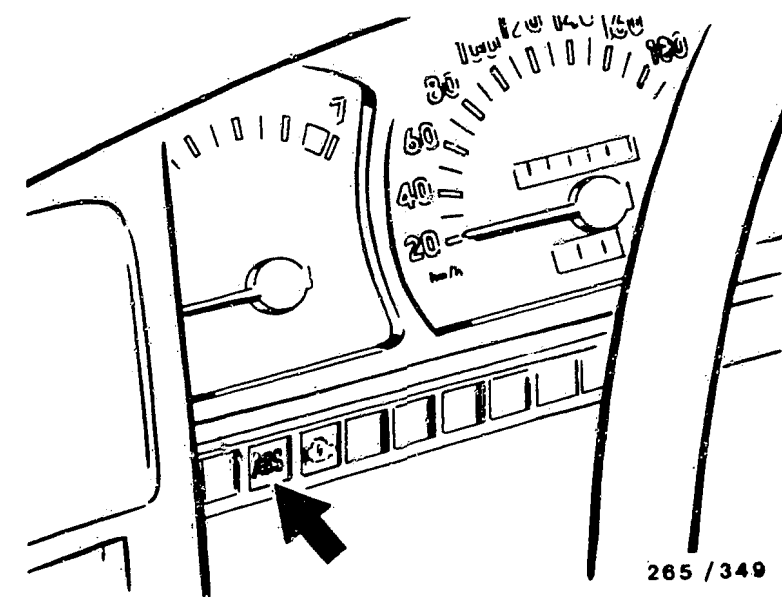
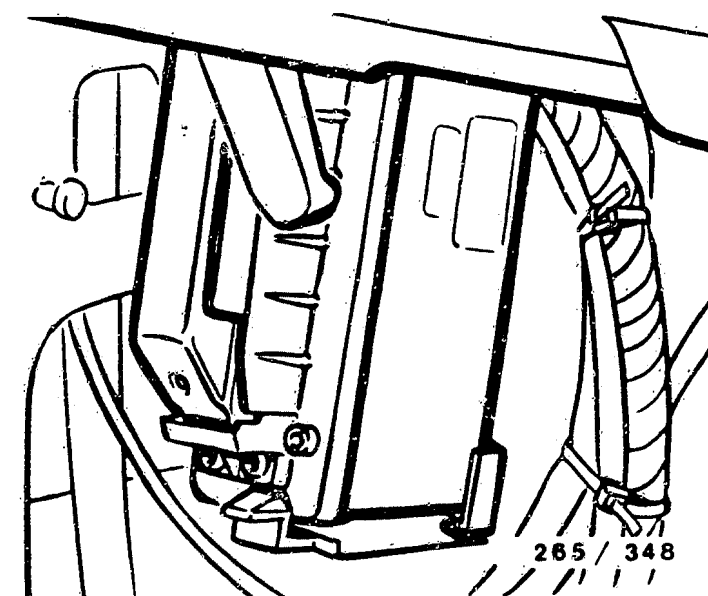
VL = Front left
 VR = Front right
 H = Rear axle
 HL = Rear left
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM

INSTALLATION POSITION OF COMPONENTS

The stated installation locations are always referenced to the direction of travel.

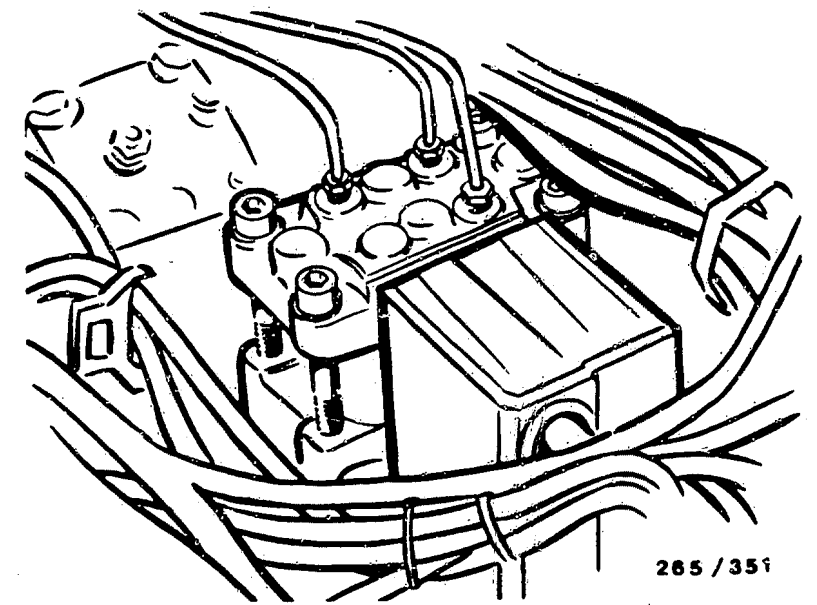
- * Controller: top picture
In driver's footwell on left-hand outer side.
- * ABS warning lamp: center picture
In instrument panel in indicator-lamp strip; 3rd lamp from left.
- * Over-voltage protection relay: bottom picture
In engine compartment, on left next to bulkhead in relay holder (arrow).



INSTALLATION POSITION OF COMPONENTS (CONTINUED)

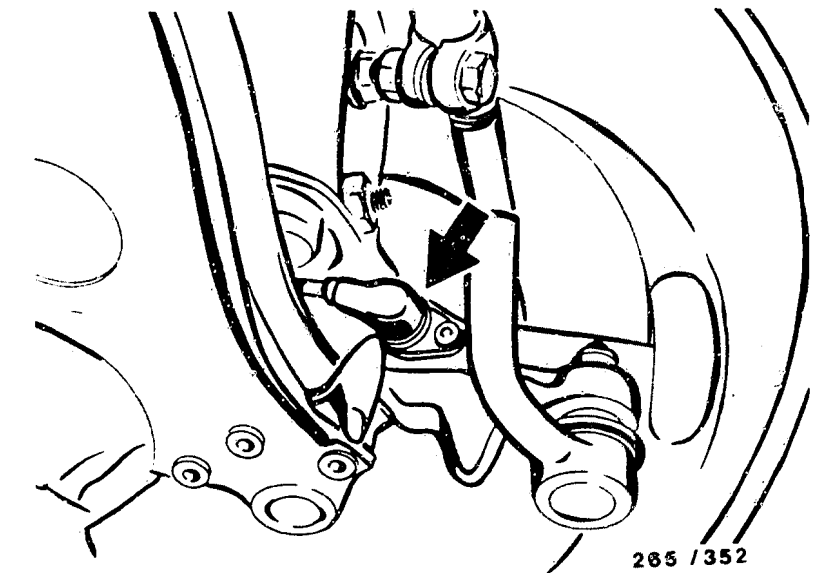
* Hydraulic modulator: top picture

In front left of engine compartment.



* Front-axle wheel-speed sensor: bottom picture

One each at either wheel in steering knuckles.
Wheel-speed sensors cannot be adjusted.



INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Rear-axle wheel-speed sensor: top picture

One each to left and right of differential.

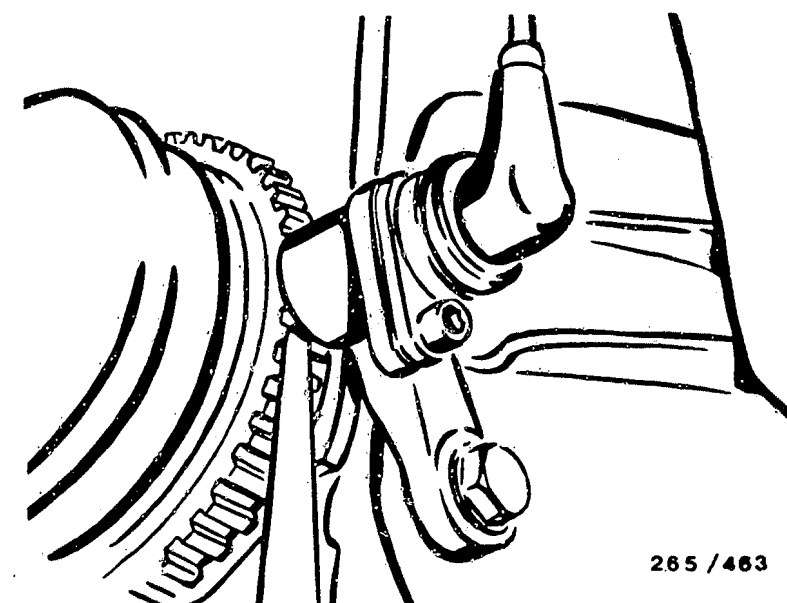
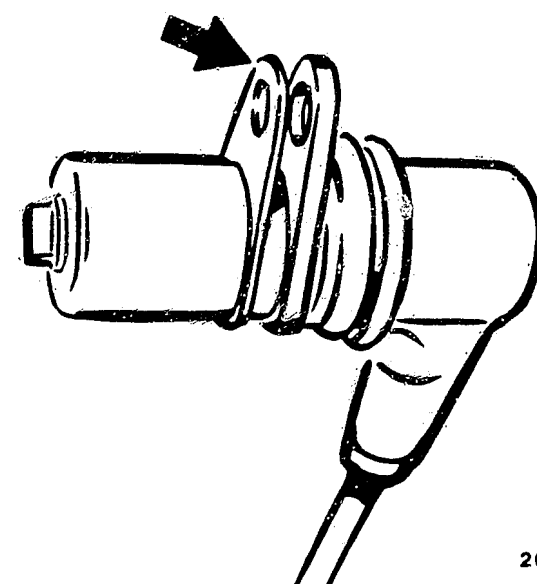
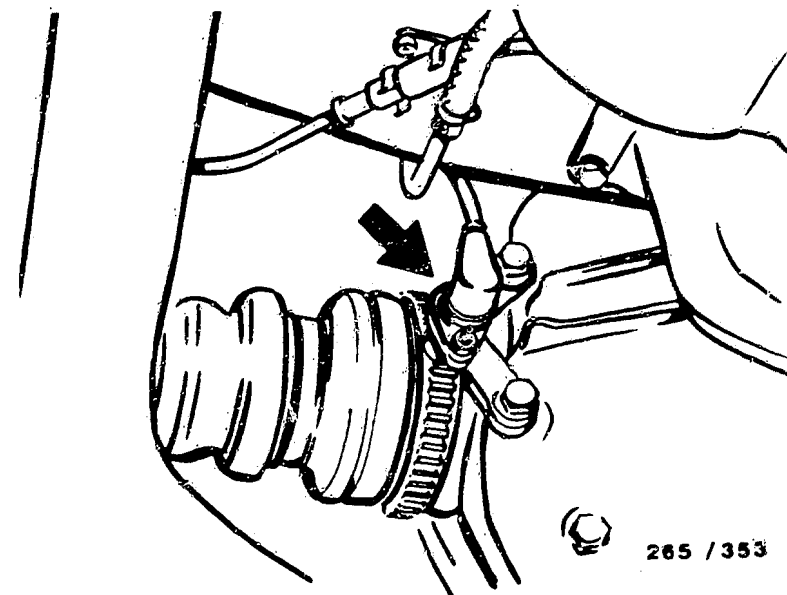
Center picture

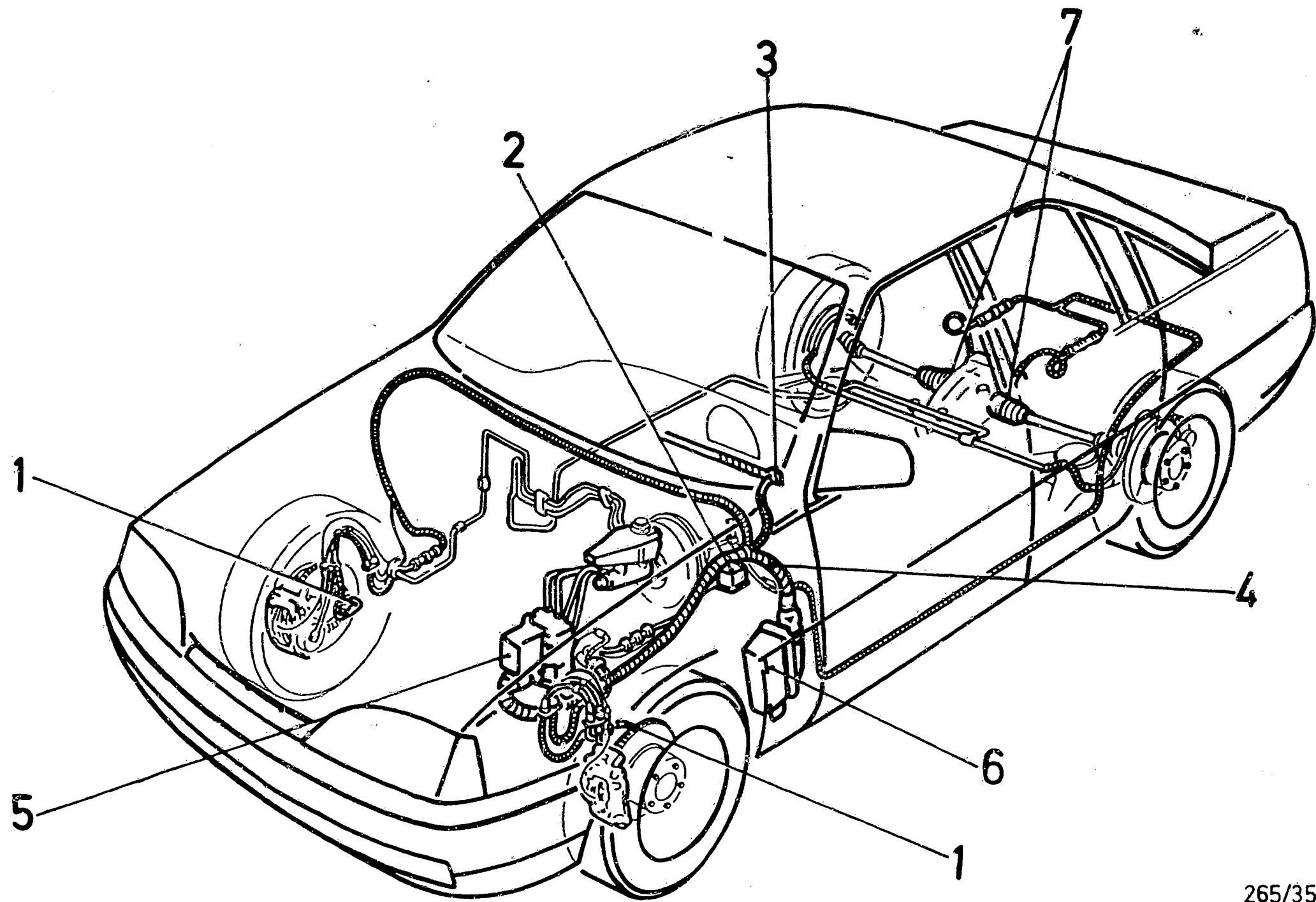
Important: pay attention to air gap when replacing wheel-speed sensors.

Air gap can be adjusted with washers (arrow).

Bottom picture

Measure air gap between ring gear and wheel-speed sensor with feeler gauge. Set air gap to between 0.5 and 1.5 mm.





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INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- 1 = Wheel-speed sensors, front axle
- 2 = Overvoltage-protection relay
- 3 = ABS - warning lamp
- 4 = ABS - wiring harness

- 5 = Hydraulic modulator
- 6 = ABS controller
- 7 = Wheel-speed sensors, rear axle

Trouble-shooting instructions : VOL-5004

BOSCH system : LH 2.4-Jetronic

Make of vehicle : VOLVO

Basic microcard : PKW-114

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 2.316 1/4-cyl. engine:

Volvo 740 GLT 16 V
EU, J, USA version 04.88->

- * LH2.4 Jetronic with 35-pole control unit
0 280 000 549
- * Engine-speed triggering by way of TN signals from term. 17 of ignition control unit.
- * Self-diagnosis with flashing-code output.
- * Diagnosis unit for displaying and activating self-diagnosis.
- * Lambda closed-loop control with adaptive basic adjustment.
- * Adaptive idle-speed regulation with single-winding rotary actuator.
- * Pulsed tank ventilation valve.
- * Twin temperature sensor (engine) for Jetronic and ignition.
- * Auxiliary relay for injection valves for radio interference suppression.
- * Use pressure gauge and hoses of pressure measuring instrument for testing fuel pressure.
- * Connect connecting element KDJE-P 100/14 between fuel supply line.

SPECIAL FEATURES (CONTINUED)

Self-diagnosis with flashing-code output:

CAUTION: Do not detach control-unit plug and do not disconnect battery, as otherwise fault memory will be cleared.

Scope of diagnosis:

- * Self-diagnosis, readout of fault memory
- * Switching-input diagnosis
- * Actuator diagnosis

Test prerequisites:

Voltage supply, positive and negative, of control unit O.K.

Battery positive: connected to term. 4 and via
main relay, term. 87/1 to term. 9

Positive of term. 15: connected to term. 35

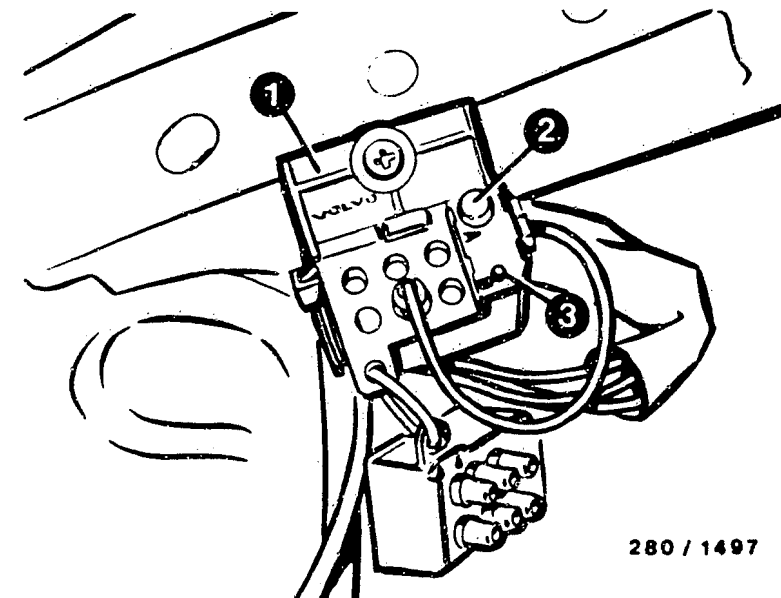
Ground: connected to term. 5 and term. 17

Self-diagnosis is effected by way of a flashing code. An indicator lamp (LED) is provided for this purpose in the diagnosis unit at the left-hand spring-strut dome.

Following elimination of fault, clear fault memory and repeat test as a check.

Note: Clearing is only possible when all faults have been output at least once. They cannot be cleared by switching off the ignition.

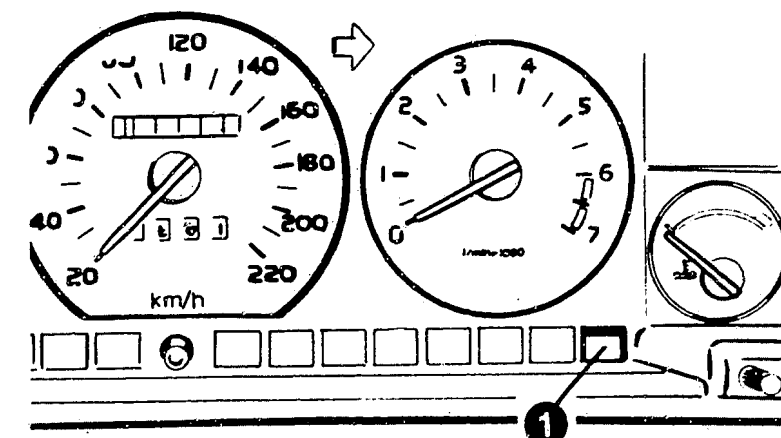
- * The presence of faults of relevance to exhaust emissions and safety (carb faults) are indicated by the check-engine lamp in the instrument panel.



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- 1 = Diagnosis unit
- 2 = Button
- 3 = Indicator lamp (LED)

- 1 = Check-engine lamp



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SPECIAL FEATURES (continued)

Activation of self-diagnosis:

If the fault memory has been cleared:

- * Test run for at least 5 minutes
- * Coolant temperature at least 80° C.
- * Engine speed must exceed 3000 min⁻¹ at least once.
- * Accelerator pedal must be completely depressed at least once.
- * If the engine doesn't run, start for at least 6 seconds and leave ignition "ON".

Self-diagnosis can be activated with the engine running (idling speed) as well as with the engine not running and the ignition on.

The flashing code "1 1 1" is output if no fault has been stored.

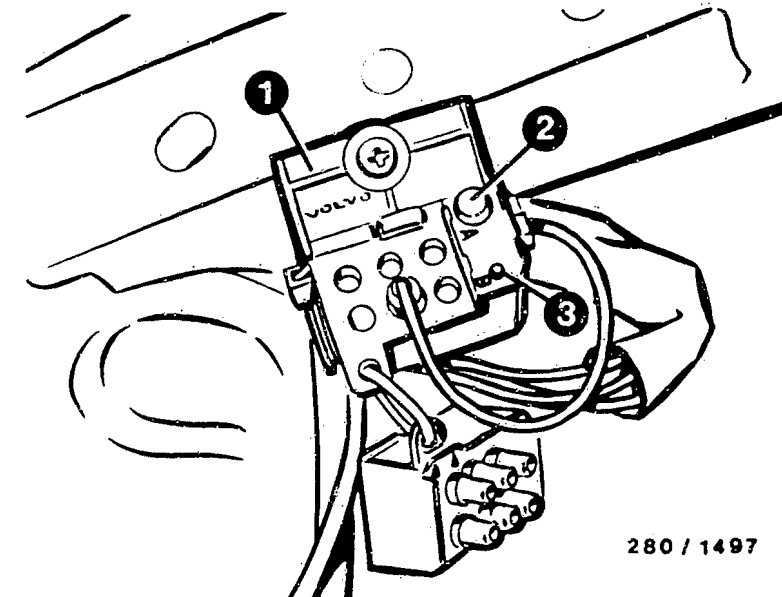
ACTIVATION OF SELF-DIAGNOSIS: Insert lead of diagnosis unit into socket 2. Press button for at least 2.5 s. Flashing code is displayed by way of the indicator lamp (LED).

ACTIVATION OF SWITCHING-INPUT DIAGNOSIS: Insert lead of diagnosis unit into socket 2. Press button twice for at least 2.5 s. Flashing code is displayed by way of indicator lamp (LED). A switch-actuation prompt causes the indicator lamp to flash. Following actuation, the respective switch code is displayed by way of the indicator lamp.

ACTIVATION OF ACTUATOR DIAGNOSIS: Insert lead of diagnosis unit into socket 2. Press button 3 times for at least 2.5 s. Indicator lamp (LED) flashes in line with actuation rhythm of component actuated. The components are actuated consecutively. The control unit switches off automatically following three repeats.

CLEARING FAULT MEMORY: Switch on ignition. Press button for at least 5 seconds. Wait until indicator lamp (LED) lights up. Press button again for at least 5 seconds.

Activate self-diagnosis again after memory has been cleared. The indicated fault code must be "1 1 1".



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- 1 = Diagnosis unit
- 2 = Button
- 3 = Indicator lamp (LED)

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

										Cause (component fault)
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*	*	*	*	*	*	*	*	*	*	Switching-input diagnosis
*	*	*	*	*	*	*	*	*	*	Actuator diagnosis
*			*							Voltage at control unit
*	*	*	*		*					Intake system
*		*	*	*		*	*			Solenoid-operated injection valves
				*	*					Fuel delivery
*	*	*	*		*	*				Fuel pressure
	*	*	*				*			Tank ventilation system
*		*								Start control
			*							Overrun cutoff
		*	*		*	*				Throttle valve
		*	*	*	*	*		*		Lambda closed-loop control
					*					Catalytic converter
*		*	*	*						Interference
	*									Pump noise

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Term- inals	Set values
1 1 1	No fault detected		—	—
1 1 2	Control unit	This fault is indicated by the check-engine lamp lighting up continuously when driving. Replace control unit without performing further testing.	—	—
1 1 3	Solenoid-operated injection valves	Test injection-valve internal resistance: Test connecting leads between control unit and injection valves for short-circuit and open-circuit. Check leads of main relay via auxiliary relay	18	14.5...17.5 Ω
1 2 1	Hot-wire air-mass sensor	Switch on ignition Measure voltage at connector: Start engine Measure voltage at connector: Voltage is a function of load Test resistance at hot-wire air-mass sensor:	5 - 1 (+) (-) 3 - 2 (+) (-) 3 - 2	8...15 V 2...5 V 2,5...3,1 Ω
1 2 3	Temperature sensor (engine) and lead	Measure resistance directly at temperature sensor: +15...+30°C: approx. +80°C: Test leads from control unit to temperature sensor (NTC).	13 -NTC NTC- 1	1.45...3.3 k Ω 280...360 Ω Approx. 0 Ω Approx. 0 Ω
1 3 1	No engine-speed signal	Check lead from LH control unit, term. 1 to EIK control unit for continuity. Test ignition signal with motortester at control unit, term. 1.	1 - 17	Approx. 0 Ω

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Terminals	Set values
1 3 2	Supply voltage of control unit with engine running	Supply voltage too low: Check voltage drop at positive and ground terminal. Charge battery, check alternator system. Supply voltage too high: Check alternator system.	9 - 5 (+) (-)	8...15 V with engine running
1 3 3	Throttle-valve switch, idle and lead.	Incorrect idle-switch setting. Check resistance directly at throttle-valve switch. Throttle valve closed: Throttle valve open: Check lead from control unit to throttle-valve switch.	2 - 18 2 - 2	0 Ω Infinity Ω Approx. 0 Ω
2 1 2	Lambda sensor	Lead to lambda sensor, open-circuit, short-circuited to ground or battery voltage. Watch out for worn cable insulation! Check sensor heating. Sensor clogged.	24	
2 1 3	Throttle-valve switch, full load and lead	Check resistance directly at throttle-valve switch. Throttle valve closed: Throttle valve completely open: Check lead from control unit to throttle-valve switch.	3 - 18 3 - 3	Infinity Ω Approx. 0 Ω Approx. 0 Ω
2 2 1	Lambda closed-loop control outside working range (control limits exceeded or dropped below)	Lead to lambda sensor: open-circuit, short-circuited to ground or battery voltage Watch out for worn cable insulation! Check sensor heating. Sensor clogged Intake system leaking Tank ventilation valve permanently open Injection valves defective Hot-wire air-mass sensor defective	24	

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Term- inals	Set values
2 2 3	No idle-speed- regulation function	Check voltage supply at idle actuator: Check lead from control unit to idle actuator for continuity. Check resistance directly at idle actuator: Check signal at control unit.	2-grd. 32	8...15 V Approx. 0 Ω 4...12 Ω
2 3 1	Adaptation limits of lambda closed-loop control (multi) reached	Check intake system for leaks. Check lambda clsd.-lp. ctrl. for proper functioning. Check fuel pressure. Check tank ventilation system.		
2 3 2	Adaptation limits of lambda closed-loop control (additive) reached	Check inj. valves for proper functioning and leaks. Check hot-wire air-mass sns. for proper functioning. Fuel tank emptied.		
3 1 1	Speed signal	Check signal at control unit Check lead from speed sensor to control unit for continuity.	34 34	Approx. 0 Ω
3 1 2	Lambda open-loop ctrl. (knock enrichment)	Check lead from control unit to ignition control unit for continuity.	28 - 4	Approx. 0 Ω
3 2 2	Self-cleaning of hot wire	Check lead from control unit to hot-wire air-mass sensor for continuity.	8 - 4	Approx. 0 Ω

SWITCHING-INPUT-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Term- inals	Set values
---	Idle switch	LED flashes, actuate idle switch. LED flashes with respective flashing code following actuation of switch.	2	Flashing code 332
---	Full-load switch	LED flashes, actuate full-load switch. LED flashes with respective flashing code following actuation of switch.	3	Flashing code 333
---	No engine-speed signal	LED flashes, start engine. LED flashes with respective flashing code after starting.	1	Flashing code 331
---	A/C preparation switch	LED flashes, actuate A/C preparation switch. LED flashes with respective flashing code following actuation of switch.	15	Flashing code 114
---	A/C compressor switch	LED flashes, start engine. Actuate air-conditioning switch. LED flashes with respective flashing code following actuation of switch/switch-on of compressor.	14	Flashing code 134
---	Drive switch (automatic only)	LED flashes, actuate drive switch. LED flashes with respective flashing code following actuation of switch.	30	Flashing code 124

ACTUATOR-DIAGNOSIS TEST TABLE

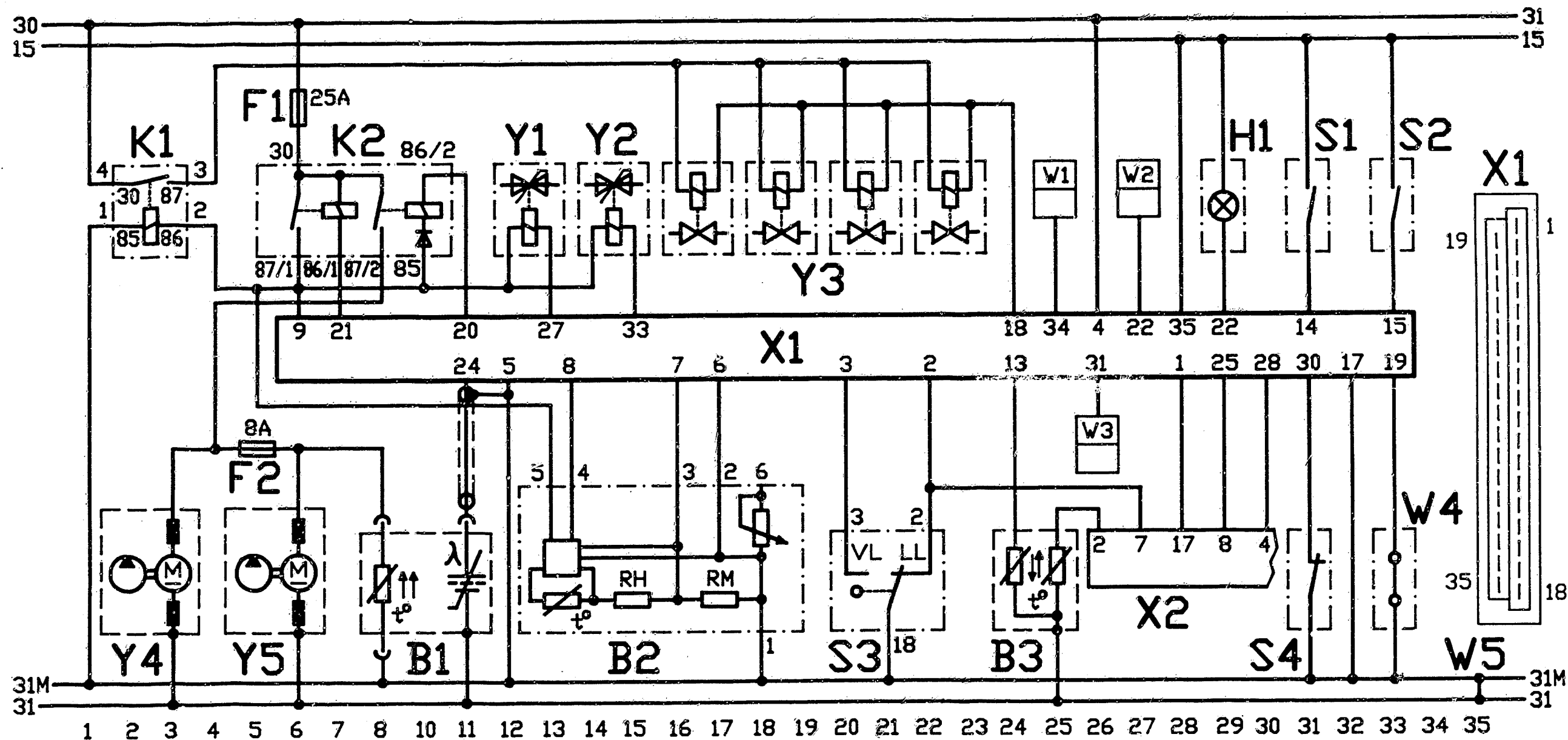
Fault indication Flashing code	Testing of component/function	Test instructions/ Test conditions	Terminals	Set values
	Solenoid-operated injection valves	<p>Detach plugs from all injection valves. Connect one injection valve in each case. It must be possible to hear connected injection valve working. Perform test consecutively on all injection valves.</p> <p>Test injection-valve int. resistance (+15...+30°C)</p> <p>Check connecting leads from control unit to injection valves for short-circuit and open-circuit.</p> <p>Check main-relay lead.</p>	18	<p>Indicator lamp (LED) flashes in line with component actuation rhythm</p> <p>14.5...17.5 Ω</p>
	Idle actuator	<p>It must be possible to hear/feel idle actuator working.</p> <p>Test idle-actuator internal resistance (+15...+30°C)</p> <p>Check leads from control unit/ignition and starting switch to idle actuator for short-circuit and open-circuit.</p>	33	<p>Indicator lamp (LED) flashes in line with component actuation rhythm</p> <p>4...12 Ω</p>
	Tank ventilation valve	<p>It must be possible to hear/feel tank ventilation valve working.</p> <p>Test internal resistance of tank ventilation valve.</p> <p>Check leads from control unit/ignition and starting switch to tank ventilation valve for short-circuit and open-circuit.</p>	27	<p>Indicator lamp (LED) flashes in line with component actuation rhythm</p> <p>35...55 Ω</p>

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Delivery at return line:	min. 800 cm ³ /30 s
* Supply voltage under load:	min. 12 V
* Delivery of pre-supply pump:	min. 900 cm ³ /30 s
Pressure regulator	
* Fuel pressure with engine stopped:	2,8...3,2 bar
at idle:	Approx. 0.5 bar less
Fuel system, leakage	
* Fuel pressure after engine has been stopped for 20 min.:	min. 1.0 bar
Idle actuator	
* Resistance at +15...+30°C :	4...12 Ω
Hot-wire air-mass sensor	
* Resistance between term. 6 and term. 3:	0...1100 Ω
term. 3 and term. 2:	2.5...3.1 Ω
Temperature sensor (engine)	
Twin version	
* Internal resistance at ambient temperature +15...+30°C:	1.45...3.3 k Ω
with engine at operating temperature approx. + 80°C:	280...360 Ω
Tank ventilation valve	
* Internal resistance:	35...55 Ω

TEST SPECIFICATIONS (continued)

Component/function	Set values
Solenoid-operated injection valve	
* Internal resistance at ambient temperature +15...+30°C:	14.5...17.5 Ω
* Leakage after 60 s:	no droplets may drip off
Start control	
* Voltage at injection valve on start initiation:	greater than 1.5 V
after approx. 15 s:	approx. 0.5 V
NOTE! A 10 k Ω resistor is to be connected up in the lead to the control unit in place of the twin temperature sensor.	
Idle-speed adjustment	
Engine at operating temperature, approx. +80°C	
* Idle speed:	800...900 min ⁻¹
No need for adjustment since engine-speed regulation is adaptive.	
CO content	
Engine at operating temperature, approx. 80°C	
* (CO sampling ahead of catalytic conv.)	0,2...1,0 vol.% CO
No need for adjustment as lambda closed-loop control is adaptive.	
Lambda-sensor heating	
* Internal resistance (PTC) with engine not running:	1...15 Ω
Please refer to equipment and Autodata microcard for settings as regards ignition, valve clearance and other engine-related data.	



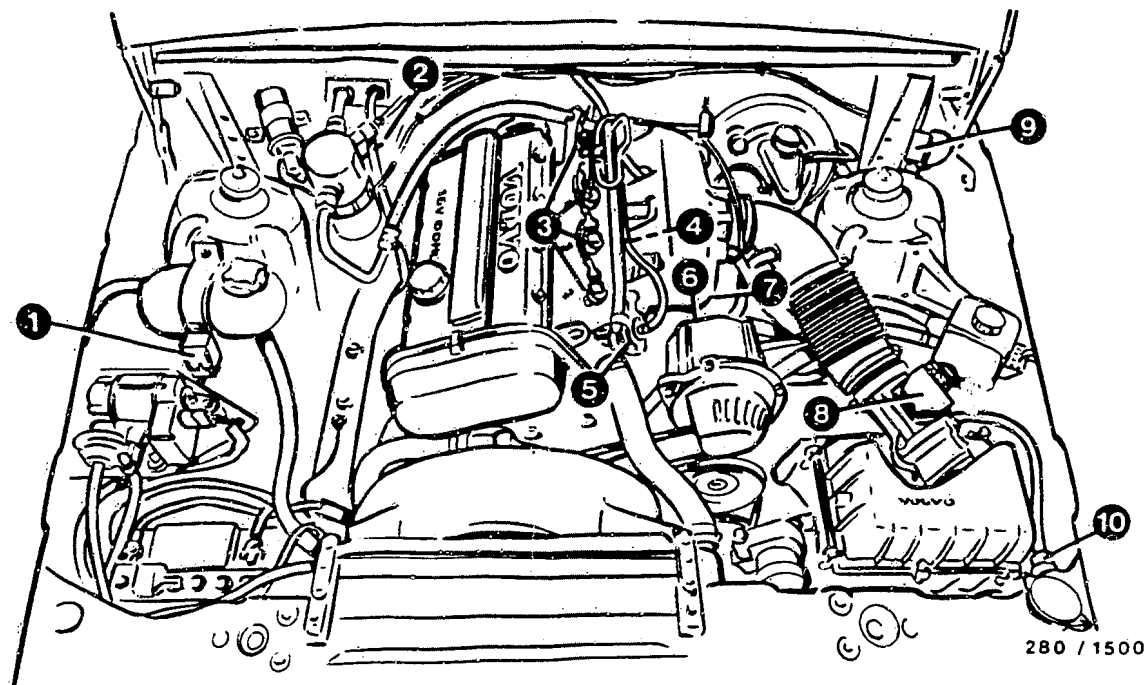
B1 = Heated lambda sensor
 B2 = Hot-wire air-mass meter
 B3 = Twin temperature sensor
 (engine)

F1 = Main/pump fuse
 F2 = Sensor-heater fuse
 H1 = Check-engine lamp
 K1 = Aux. relay (interference-suppress.)

K2 = Main/pump relay
 S1 = A/C switch
 S2 = A/C readiness
 S3 = Throttle-valve switch
 S4 = Drive switch
 W1 = Speed sensor
 W2 = Diagnosis prompt
 W3 = Consumption output

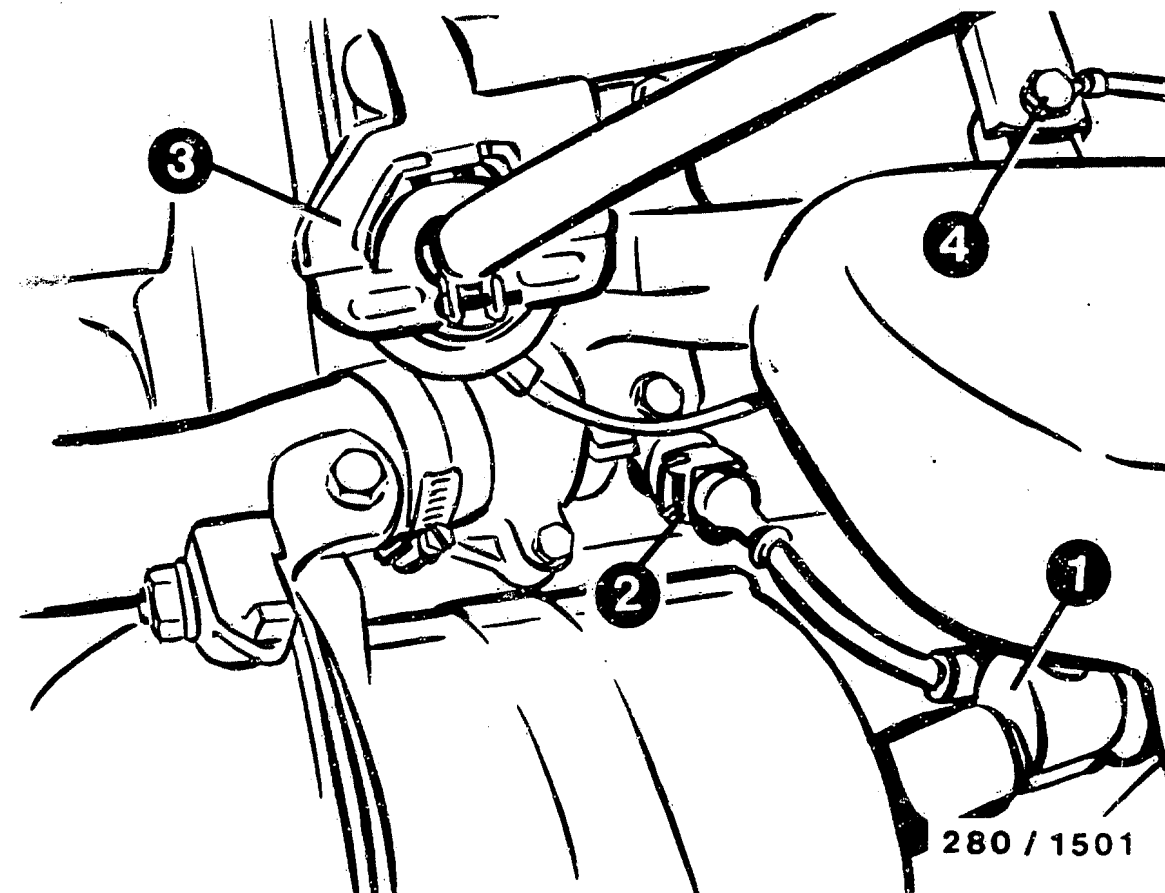
W4 = Data encoding
 X1 = Control-unit plug - Jetronic
 X2 = Control-unit plug - ignition
 Y1 = Tank ventilation valve
 Y2 = Single-winding rotary actuator
 Y3 = Solenoid-operated injection valves
 Y4 = Electric fuel pump
 Y5 = In-tank pre-supply pump

ELECTRICAL TERMINAL DIAGRAM



INSTALLATION POSITION OF COMPONENTS

- 1 = Auxiliary relay
- 2 = to plug connection of lambda sensor
- 3 = Solenoid-operated injection valves
- 4 = Ground terminal
- 5 = Pressure regulator
- 6 = to temperature sensor (engine)
- 7 = to idle actuator
- 8 = Hot-wire air-mass sensor
- 9 = Diagnosis unit
- 10 = Tank ventilation valve



- 1 = Idle actuator
- 2 = Temperature sensor (engine)
- 3 = Pressure regulator
- 4 = Ground terminal

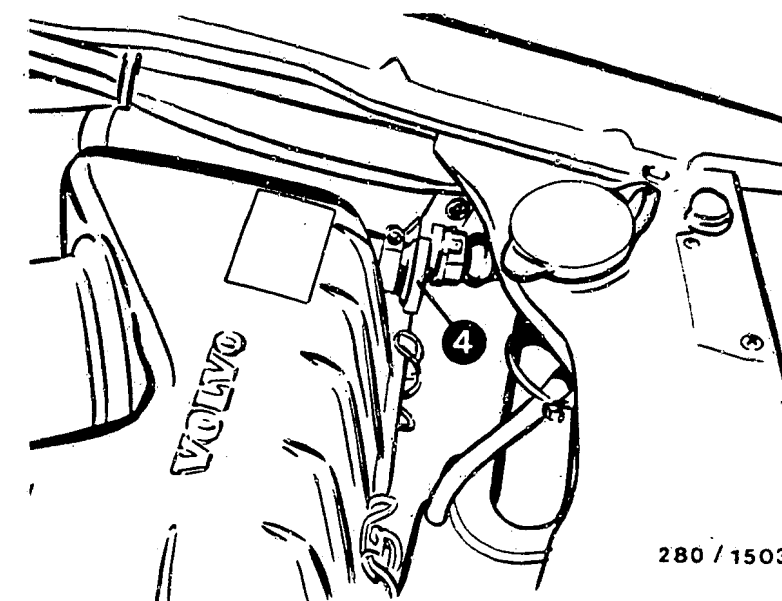
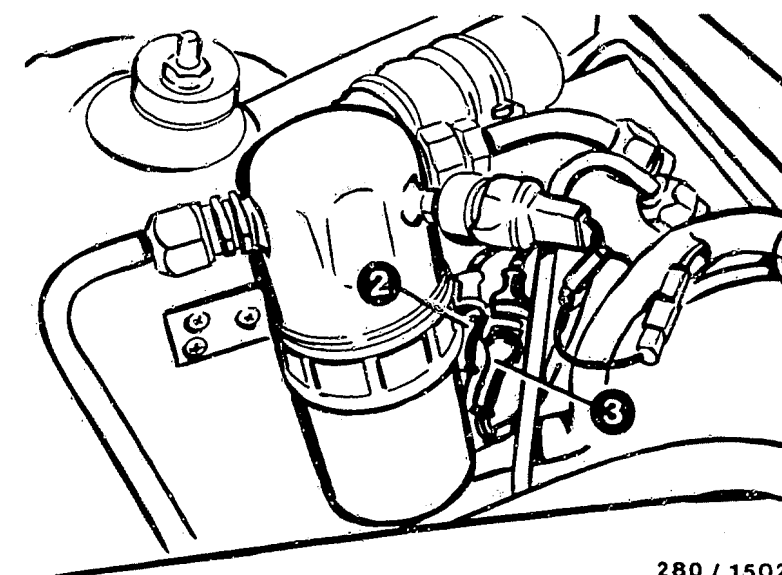
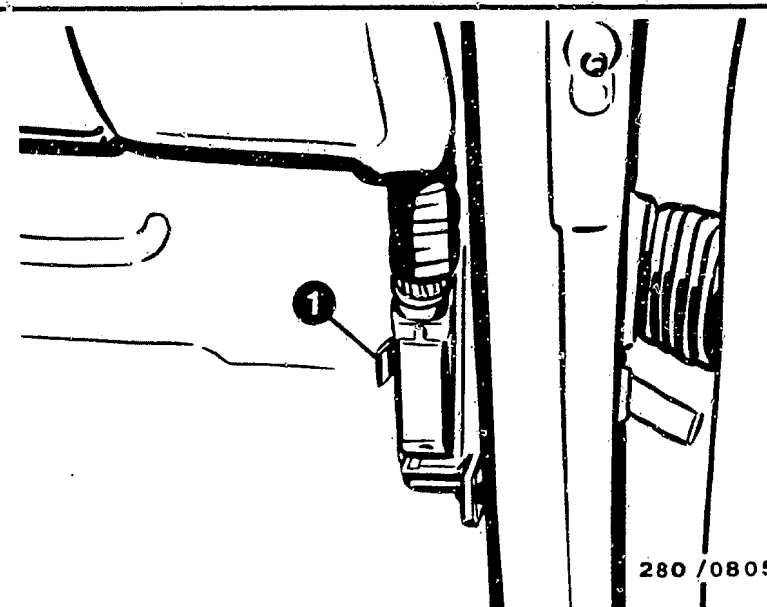
INSTALLATION POSITION OF COMPONENTS (continued)

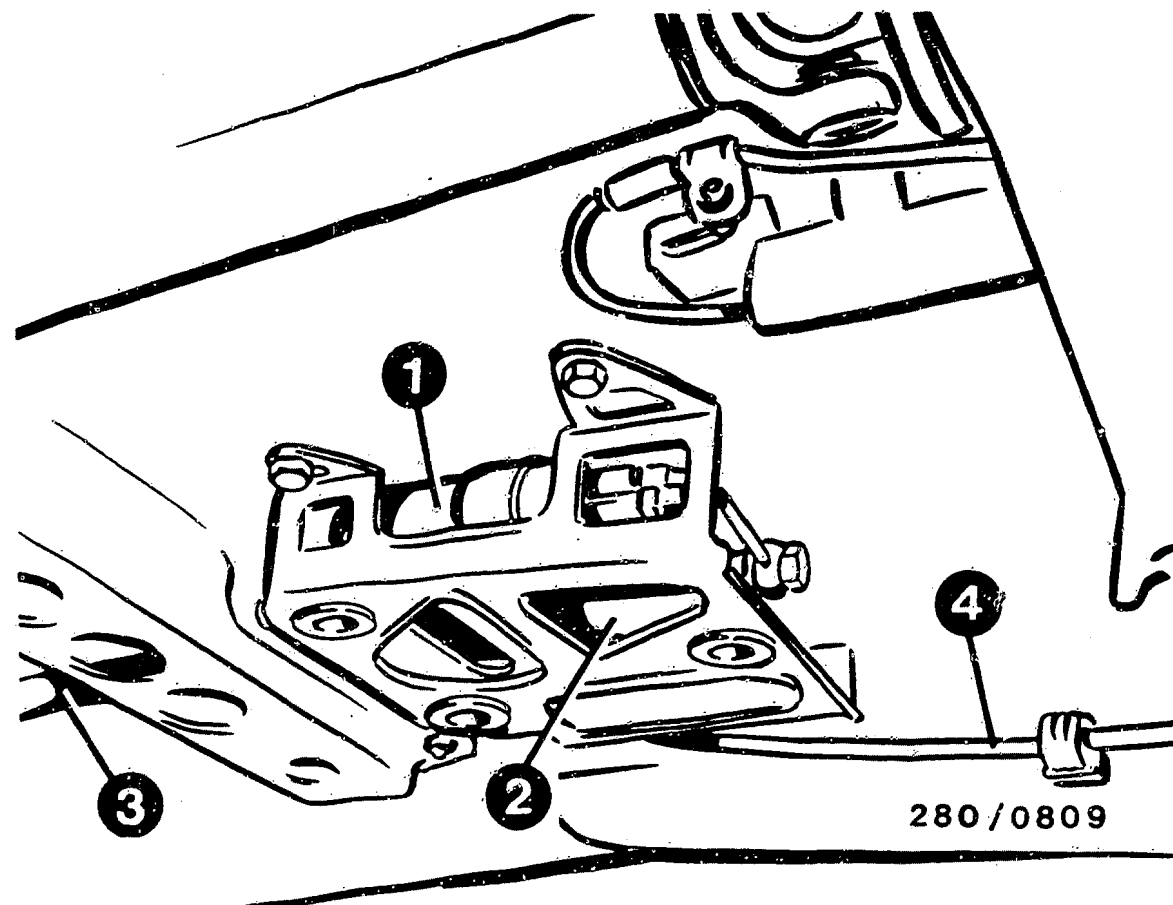
INSTALLATION POSITION OF COMPONENTS (continued)

- 1 = Control unit
- 2 = Lambda-sensor plug connection
- 3 = Lambda-sensor-heater plug connection
- 4 = Tank ventilation valve

The control unit is located behind a cover on the right-hand side in the front passenger's footwell.

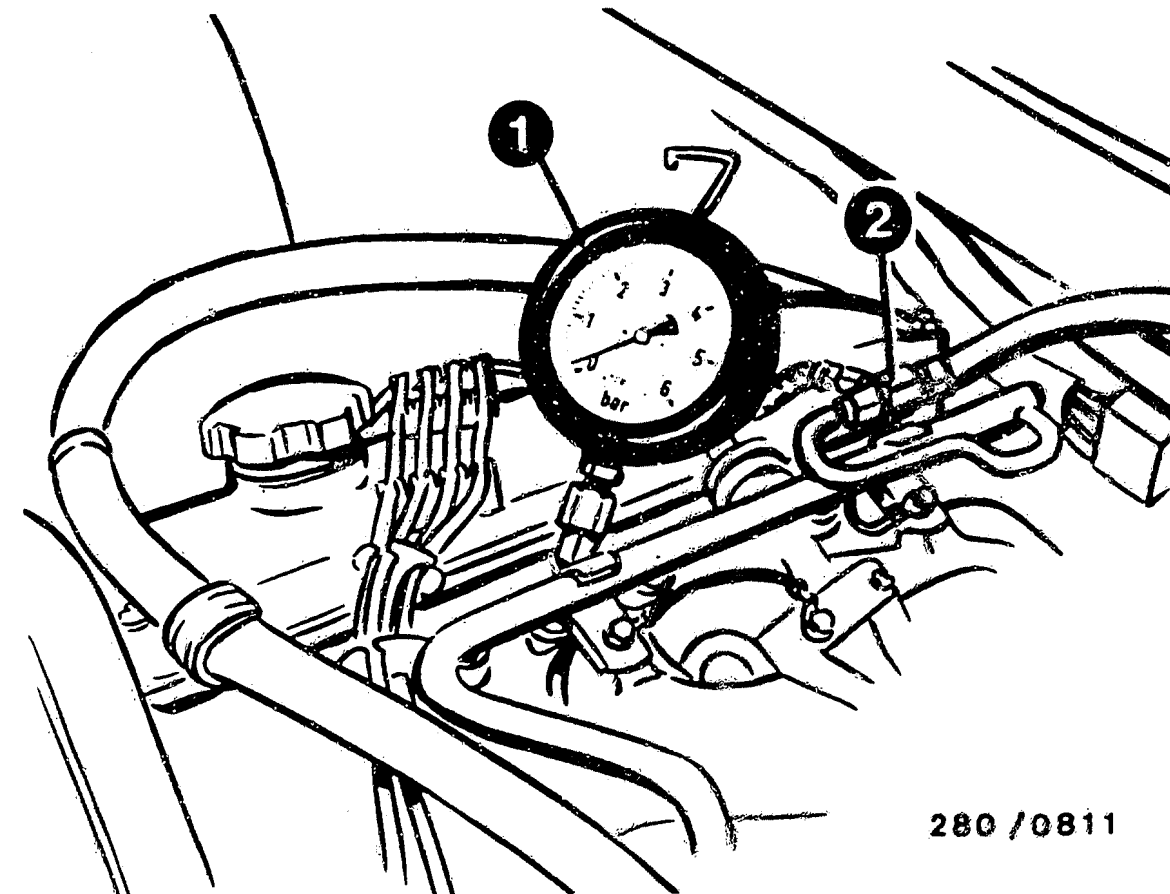
The pump fuse, main relay and pump relay are located in the passenger-compartment center console behind the ashtray.





- 1 = Electric fuel pump
- 2 = Fuel filter
- 3 = Fuel suction line
- 4 = Fuel delivery line

Pre-supply pump in tank (accessible via trunk).



- 1 = Pressure gauge
- 2 = Connection part KDJE-P 100/14

Fuel pressure test

CAUTION! When unscrewing hose, ensure that no fuel gets on to hot parts of engine.

Connect pressure gauge or pressure measuring device. Unscrew fuel delivery line at fuel distribution pipe.

Connect up connection part KDJE-P 100/14. Make sure connection is tight.

Trouble-shooting instructions : ALF-5011
BOSCH system : L3.2-Jetronic
Make of vehicle : ALFA ROMEO
Basic microcard : PKW-118

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle model:

ALFA ROMEO 33 1.7 i.e. 10.87->
with 1.712 l / 4-cyl. engine

- * L3.2-Jetronic with 15-pole control unit:
0 280 000 602
- * Engine-speed triagering from term.1 of ignition coil.
- * Control unit attached directly to air-flow sensor.
- * Air-flow sensor is connected to the control unit via an internal 4-pole plug connection.
- * CO adjusting screw at control unit.
- * Actuation of electric fuel pump by control unit via pump relay.
- * Supply voltage for control unit via main relay.
- * Lambda closed-loop control
- * Start control, i.e. additional quantity of fuel injected via all injection valves.
- * Tank ventilation system with active-carbon container and vacuum-controlled tank ventilation valve.
- * Use pressure gauge and hoses of pressure measuring device KDJE-P 100 for testing fuel pressure.
- * Connect connecting piece KDJE-P 100/16 between fuel inlet line and pressure regulator.

STRUCTURE, USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

In line with the customer complaint, the trouble-shooting chart pinpoints various causes/ component faults. Detailed trouble-shooting information is given in the trouble-shooting chart in the basic instructions.

NOTE: Even if reference is made to basic instructions, the set values, terminal assignments and special features given in these vehicle-specific brief instructions are always binding.

Uniform test-step numbering facilitates location of individual test steps in the brief and basic instructions.

SAFETY AND PRECAUTIONARY MEASURES

Pay attention to the information given in the basic instructions, so as to avoid personal injury and so as to prevent engine, trigger-box, control-unit or ignition system damage.

CAUTION !
High-powered ignition system with hazardous high and low voltages!

Coming into contact with parts or terminals which carry voltage can be fatal (on both primary and secondary sides).

Avoid injection when testing compression.
The pump relay should therefore be detached.

Refer to basic instructions for other precautionary measures.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)											
*	*	*	*	*	*	*	*			*	Universal test adapter
*	*	*	*		*						Air-intake system
*	*	*	*								Auxiliary-air device
*		*	*	*	*	*					Air-flow sensor
				*	*						Fuel delivery
*	*	*	*		*	*	*				Fuel pressure, leaks
		*									Pump noise
		*		*	*	*	*				Solenoid-operated injection valves
				*							Alternator, interference suppression
*	*	*				*					Start control
				*		*					Overrun cutoff
		*	*	*		*					Engine-speed, CO adjustment
		*	*	*	*						Lambda closed-loop control
						*					Catalytic converter

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 168

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ test conditions	Set values
	V	Ω				
1	 V	5	8 - 5	Resistance of tempera- ture sensor (engine)	Only connect control-unit plug Engine temperature +15...+30 °C : approx. +80 °C :	1.45...3.3 k Ω 280...360 Ω
2	 V	6	4 - 5	Ground connection of output stage		0...10 Ω
3	 V	7	6 - 5	t v coding	Connect end of lead from term.6 to ground	0...10 Ω
4	 V	9	15 - 5	Throttle-valve switch/ resistance of idle contact	Detach plug from ignition control unit. Throttle valve closed : Throttle valve open :	0...10 Ω infinity Ω
5	 V	10	14 - 5	Throttle-valve switch/ resistance of full-load contact	Plug remains detached. Throttle valve closed : Throttle valve fully open :	infinity Ω 0...10 Ω
6	5	10	1 - 5 (+) (-)	Term.1 signal from ignition coil term.1	Attach plug of ignition control unit. Transmission in neutral, start engine	Ignition pulses on oscilloscope
7	6	10	2 - 5 (+) (-)	Voltage supply of control unit	Switch on ignition	8...15 V
8	7	10	12 - 5 (+) (-)	Winding of pump relay	Switch on ignition	8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

Adapter lead: 1 684 463 168

Test step	Switch V	Ω	Termi- nals	Testing of component/function	Test instructions/ test conditions	Set values
9	7	10	12 - 5	Simulation of electric-fuel-pump actuation	Detach connector from auxiliary-air device Switch on ignition Press test button 3	Electric fuel pump should be heard to run
9.1	7	10	12 - 5	Simulation of auxiliary-air-device actuation	Attach connector to auxiliary-air device Switch on ignition Press test button 3	Perform visual inspection to see whether air cross-section is closed off
10	7	10	12 - 5 (+) (-)	Ground actuation of pump relay term.85 by control unit	Connect up control unit Transmission in neutral, start engine Allow engine to idle	0...5 V
11	8	10	11 - 5 (+) (-)	Air-flow signal U _p output term. 11	Run engine	0...5 V load-dependent
12	9	10	7 - 5 (+) (-)	Jumper from term.7 to term.2	Run engine	8...15 V
13	10	10	3 - 5 (+) (-)	Injection pulses from control unit	Run engine	Injection pulses on oscilloscope
14	11	10	10 - 5 (+) (-)	Sensor monitoring	Run engine	0...1.0 V
15	12	10	9 - 5 (+) (-)	Reference voltage U _v output term. 9	Run engine	3.5...4.5 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)
 Adapter lead :1 684 463 168

Test step	Switch V	Ω	Termi- nals	Testing of component/function	Test instructions/ test conditions	Set values
16	10	10	3 - 5 (+) (-)	Simulation of cold engine	Run engine, press test button 1	Injection pulse wider or engine speed lower
17	10	10	3 - 5 (+) (-)	Simulation of warm engine	Run engine, press test button 2	Injection pulse must not become wider
18	10	10	3 - 5 (+) (-)	Overrun-cutoff simulation	Run engine, engine speed in excess of 2000 min ⁻¹ Press test button 5	No injection pulses, engine hunts
19	10	10	3 - 5 (+) (-)	Simulation of full-load correction	Run engine, engine speed approx. 2400 min ⁻¹ Press test button 6	Slight change in injection pulse/ engine speed
20	11	10	10 - 5 (+) (-)	Measurement output - lambda closed-loop control (mixture adjustment)	Run engine Press test button 4 Turn CO adjusting screw until voltage reading fluctuates uniformly between 0...13 V.	0...13 V fluctuating

TEST SPECIFICATIONS

Components/operation	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 600 cm ³ /30 s
* Supply voltage under load:	at least 12V
Pressure regulator	
* Fuel pressure with engine not running:	2,8...3,2 bar
at idle speed:	approx. 0.5 bar lower
Fuel system, leakage	
* Fuel pressure 20 min. after engine switched off:	at least 1.0 bar
Auxiliary-air device	
* Internal elec. resistance:	35...70 Ω
Air-flow sensor, only measurable if control unit is removed.	
* Resistance value between term.3- and term.4- :	500...1000 Ω
term.3- and term.2- :	
Air-flow sensor flap in rest position	10...200 Ω
When air-flow sensor flap is deflected, indication must change:	
Temperature sensor (intake air), only measurable if control unit is removed.	
* Internal electrical resistance, between term.3- and term.1-, at ambient temperature +15...+30 °C:	1.45...3.3 k Ω

TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
Temperature sensor (engine)	
* Internal resistance at ambient temperature +15...+30 °C :	1.45...3.3 k Ω
with engine at operating temperature approx. +80 °C :	280...360 Ω
Solenoid-operated injection valve	
* Internal resistance at ambient temperature +15...+30 °C :	14,5...17,5 Ω
* Leakage after 60 s:	no droplet may drip off
Start control	
* Voltage at injection valve Start initiation :	approx. 1.5 V
after approx. 15s:	approx. 0.5 V
Idle-speed adjustment	
Engine at operating temperature, approx. +80°C	
* Idle speed:	900...1050 min ⁻¹

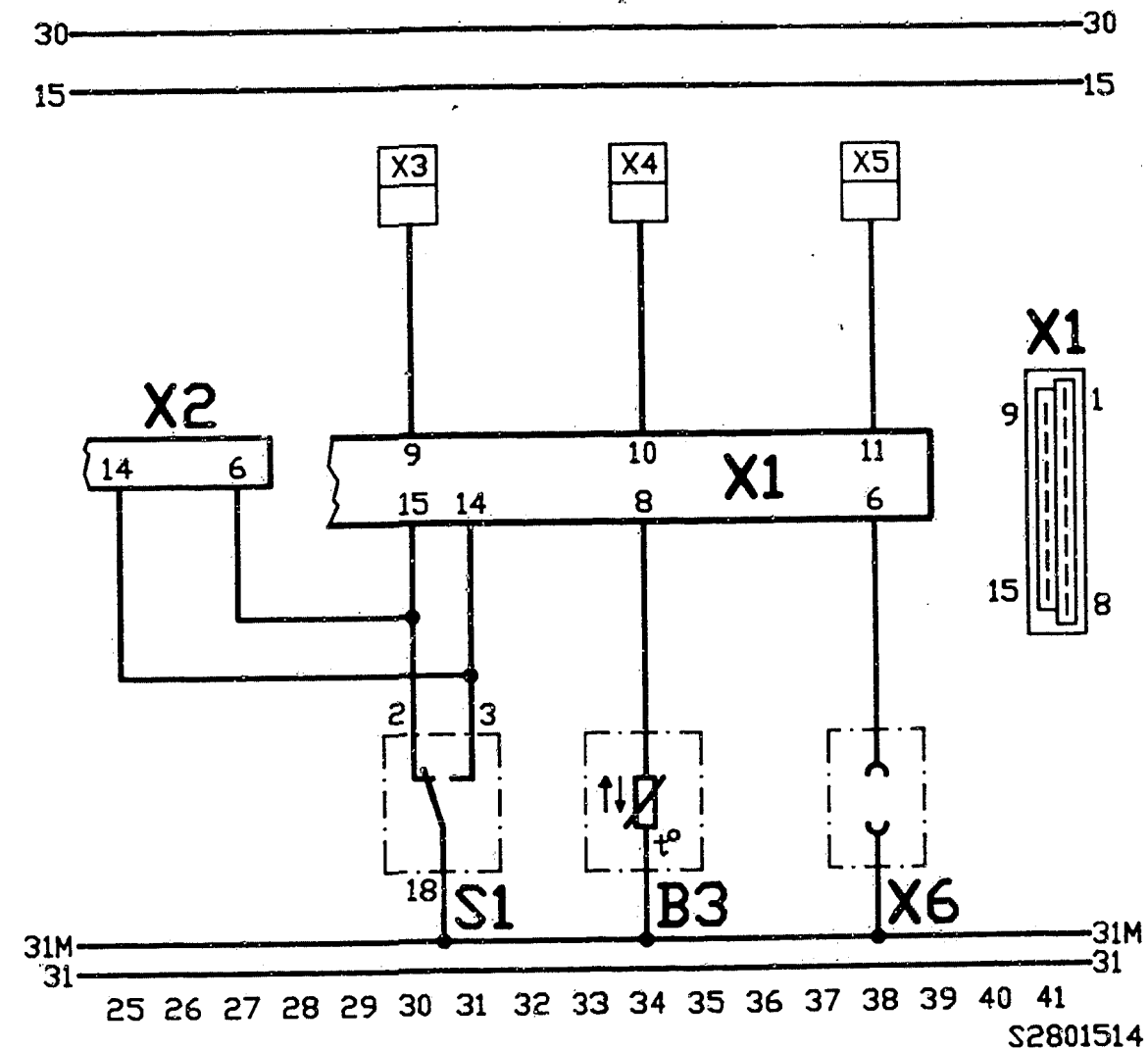
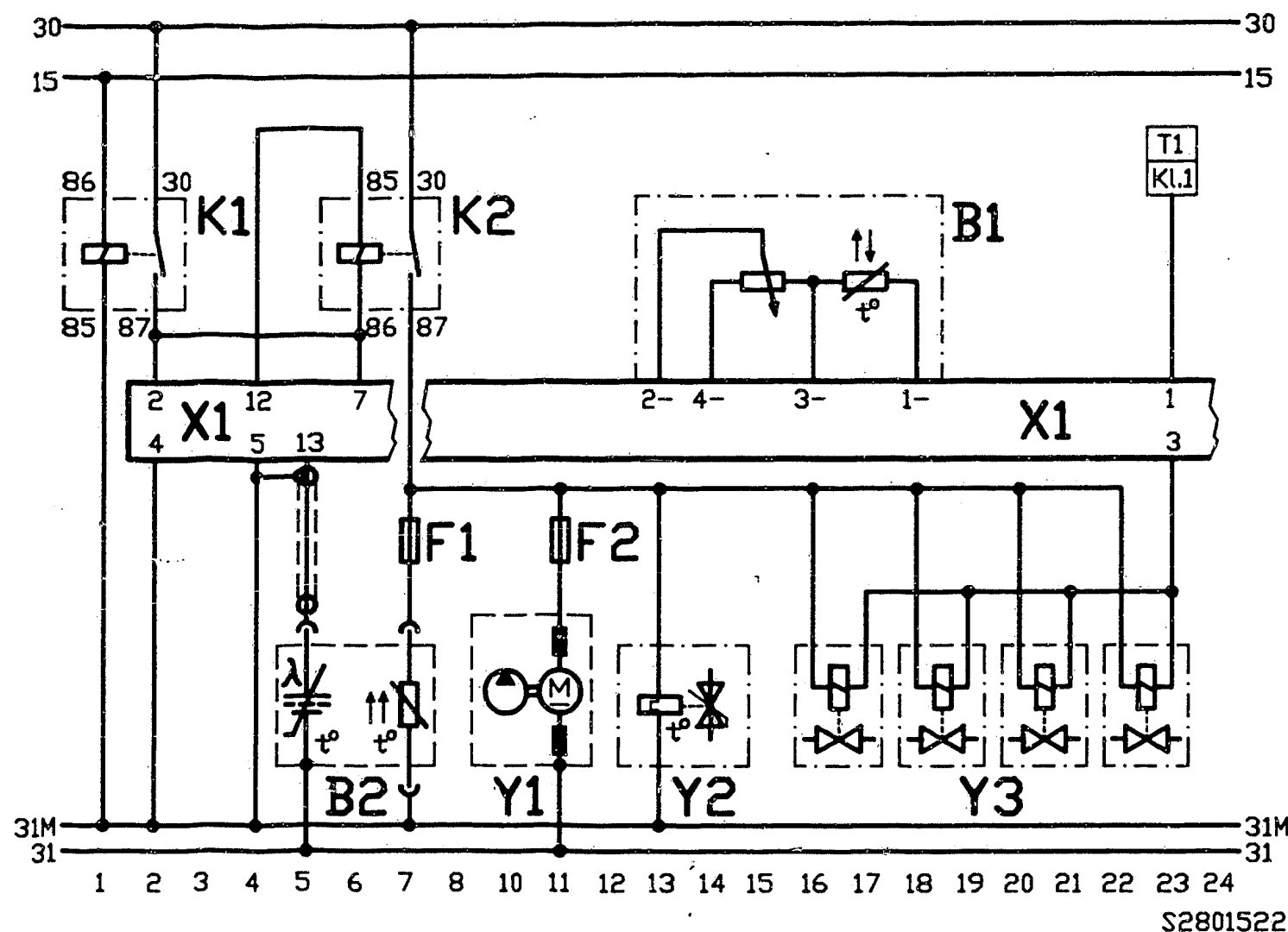
TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
CO adjustment	
Engine at operating temperature, approx. +80°C	
Short-circuit idle and full-load switch to vehicle ground.	
Integrator voltage	
(Test pin term.10)	
* Open-loop control (disconnect plug connection of sensor lead):	Fixed voltage value between 10...13 V
* Closed-loop control (connect plug connection):	Reading fluctuates between 0...13 V
* Setting:	Reading fluctuating uniformly betw. 0...13V

* Rich value (disconnect plug connection and connect control-unit lead to ground):	10...13 V
* Lean value (apply 2V to control-unit lead):	less than approx. 1.0 V

For production reasons:
continued on the following
coordinate.

Refer to equipment and Autodata microcard for settings as regards ignition and valve clearance as well as for other engine-related data.

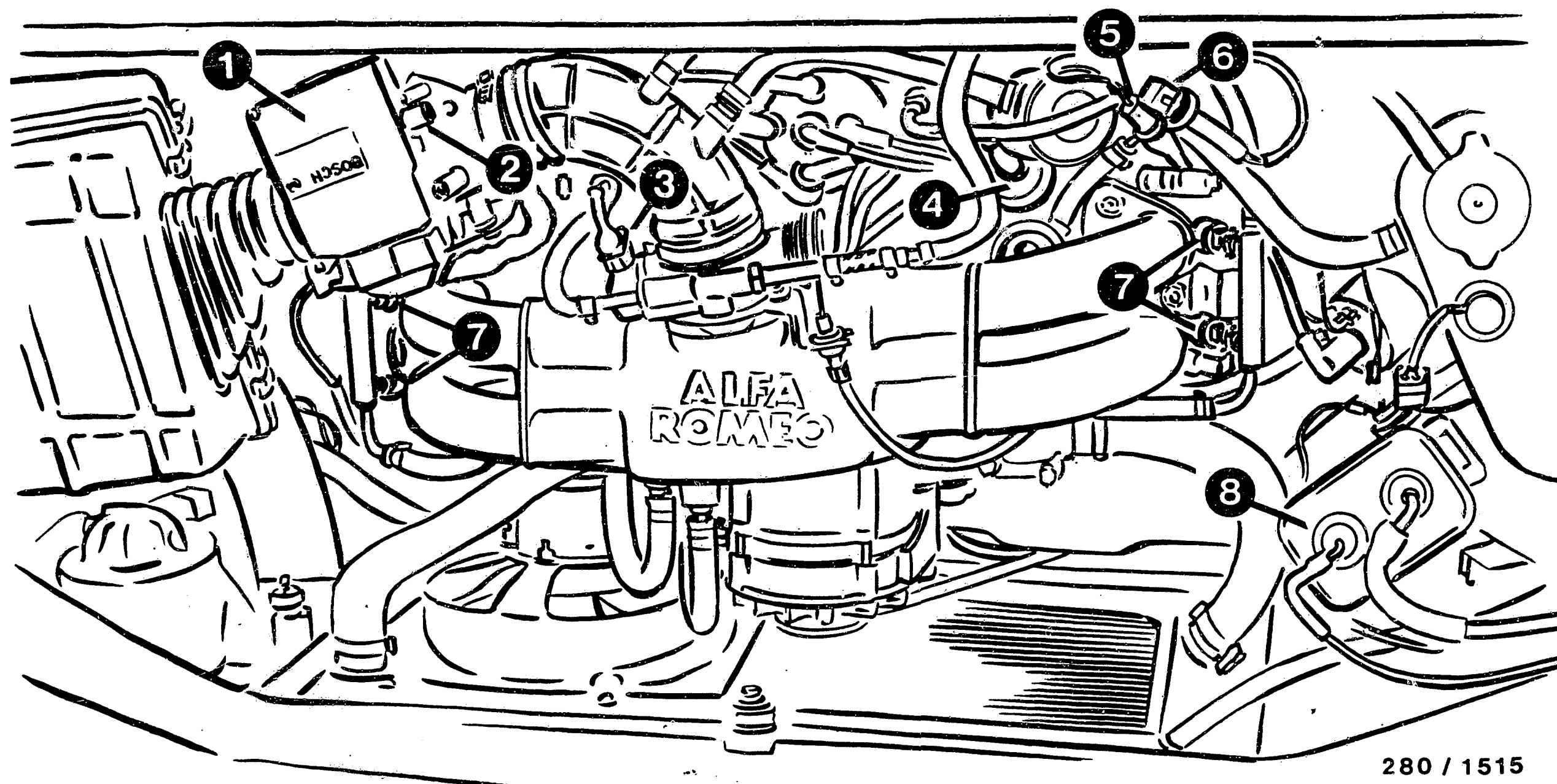


B1 = Air-flow sensor with
 temperature sensor (intake air)
 B2 = Heated lambda sensor
 B3 = Temperature sensor (engine)
 F1 = Fuse for sensor heater
 F2 = Pump fuse
 K1 = Main relay

K2 = Pump relay
 S1 = Throttle-valve switch
 X1 = Jetronic control-unit plug
 X2 = Control-unit plug (ignition)
 X3 = U_p output, reference voltage
 X4 = Test output for lambda closed-loop
 control and diagnosis output

X5 = U_p output, air-flow signal
 X6 = t_v coding or diagnosis stimulation
 Y1 = Electric fuel pump
 Y2 = Auxiliary-air device
 Y3 = Solenoid-operated injection valves

ELECTRICAL TERMINAL DIAGRAM



280 / 1515

1 = Measuring and control unit consisting
of air-flow meter and control unit
2 = CO adjustment potentiometer
(lambda closed-loop control)

3 = Throttle-valve switch
4 = Pressure regulator
5 = Plug, lambda sensor

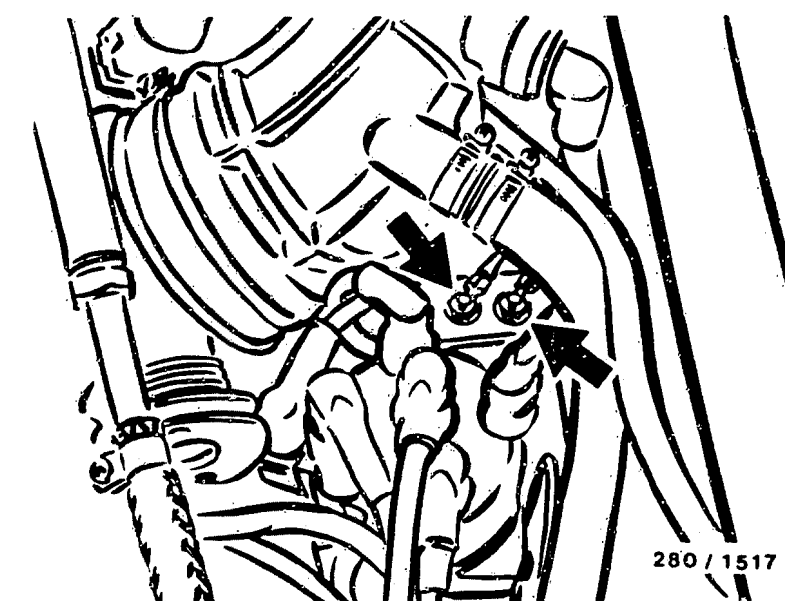
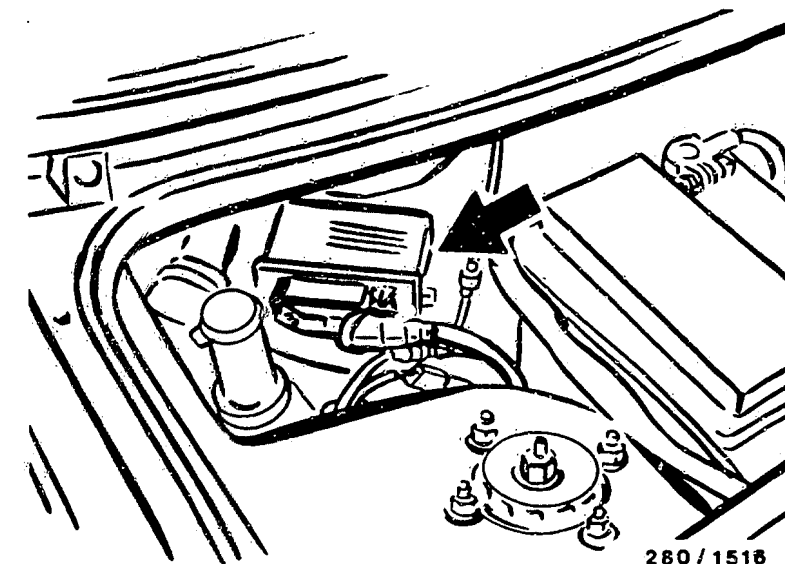
6 = Plug, sensor heater
7 = Solenoid-operated injection valves
8 = Activated carbon canister

INSTALLATION POSITION OF COMPONENTS

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The directions "left" and "right" are always with reference to the forward direction of travel.

- * Upper illustration
Arrow = Ignition control unit
- * Center illustration
Arrow = Central ground
- * Lower illustration
Arrow = Temperature sensor (engine)
On the right-hand side between the intake-manifold passages.



INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Upper illustration
 Arrow = Electric fuel pump
 At the vehicle floor behind the left-hand McPherson strut.

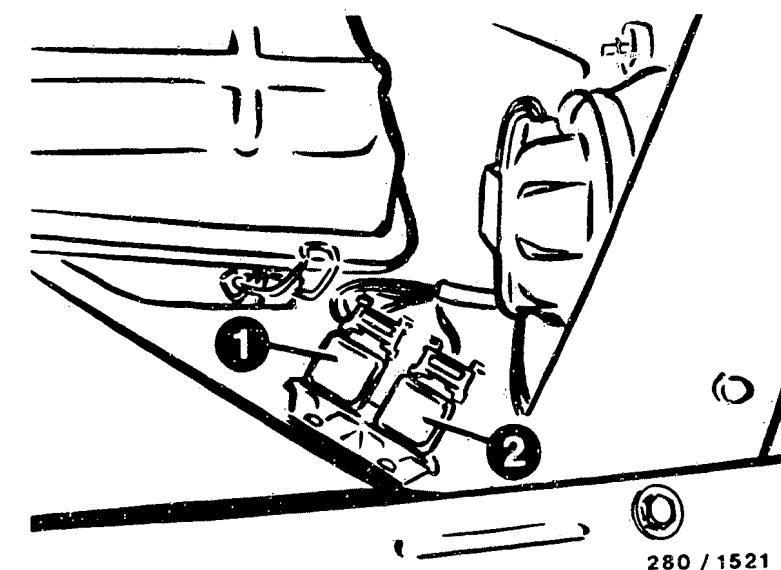
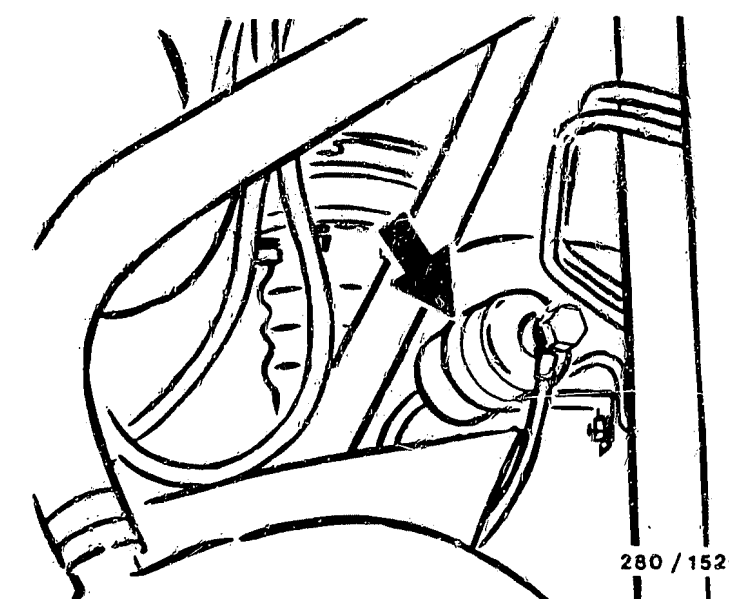
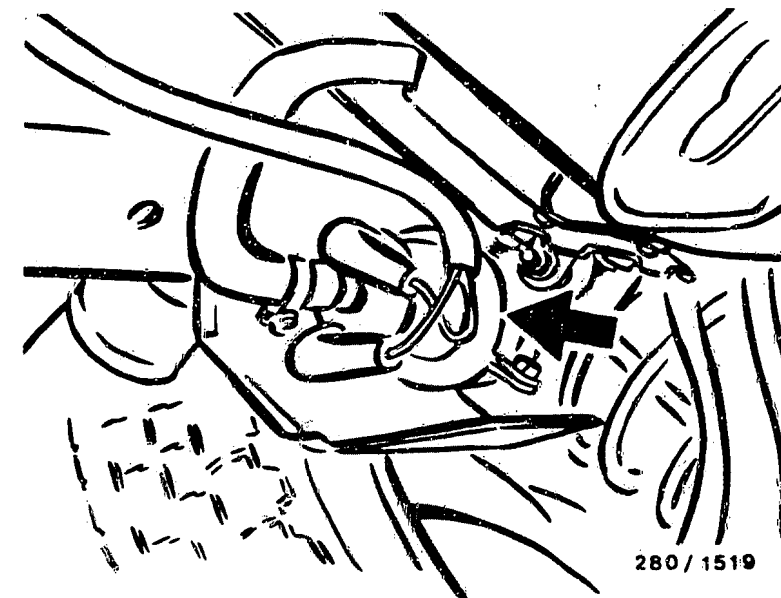
* Center illustration
 Arrow = Fuel filter

* Lower illustration
 1 = Main relay
 2 = Pump relay
 Both relays are located beneath a protective cover.

* Heated lambda sensor:
 In the exhaust pipe before the catalytic converter.

* Auxiliary-air device:
 On the right-hand side behind the intake-manifold passages.

* Tank-ventilation valve (driven by vacuum):
 Beneath the activated carbon canister.



Trouble-shooting instructions: OPE-5015

BOSCH system : L 3.1 -Jetronic

Make of vehicle : OPEL

Basic microcard : PKW-044

Section	Coordinates
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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 1.598l/4-cyl. engine:

Opel Corsa GS1 EU 03.88->

- * L3.1-Jetronic with 15-pole control unit :
0 280 000 611
- * Engine-speed triggering from term. 5 of the ignition control unit.
- * Control unit attached directly to the air-flow sensor.
- * Air-flow sensor is connected to the control unit via an internal 4-pole plug connection.
- * CO adjusting screw on control unit.
- * Twin relay for voltage supply and actuation of the electric fuel pump instead of main and pump relay.
- * Start control, i.e. additional quantity of fuel injected by way of all injection valves.
- * Use pressure gauge and hoses of pressure measuring device KDJE-P 100 for testing fuel pressure.
- * Connect 3-way line KDJE-P 100/13 between fuel inlet line and pressure damper.

STRUCTURE, USAGE

These brief instructions essentially cover the vehicle-specific special features and test specifications (set values).

Corresponding to the customer complaint, the trouble-shooting chart leads to various causes/component faults.

Detailed instructions for trouble-shooting must be taken from the basic instructions via the trouble-shooting chart.

NOTE: Even if reference is made to basic instructions, the set values, terminal assignments and special features in these vehicle-related brief instructions are always binding.

The numbering of the test steps is the same for both the brief and basic instructions in order to make it easier to find individual test steps.

SAFETY AND PRECAUTIONARY MEASURES

Keep people out of danger.

Avoid damage to the engine, control unit or ignition system.

* C A U T I O N !

High-performance ignition system.
Dangerous high and low voltages.

Do not come into contact with parts or terminals which carry voltage; danger, primary and secondary sides.

* Avoid injection when testing the compression.
Therefore, disconnect the double relay.

See basic instructions for further precautionary measures.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts with difficulty.
2. Engine starts but then dies.
3. Rough idling (Speed, exhaust).
4. Poor throttle response, poor progression.
5. Engine misfiring (Ignition, injection).
6. Engine lacks power/maximum speed not obtained.
7. Fuel consumption too high.
8. Engine diesels.
9. Engine pings/knocks.
10. Engine overheats.
11. Fault lamp.

										Cause (component fault)
*	*	*	*	*	*	*	*		*	Universal test adapter
*	*	*	*		*					Air intake system
*	*	*	*							Auxiliary-air device
*		*	*	*	*	*				Air-flow sensor
				*	*					Quantity of fuel
*	*	*	*		*	*	*			Fuel pressure, leakage
		*								Pump noises
		*		*	*	*	*			Solenoid-operated injection valves
				*						Generator, interference suppression
*	*	*			*					Starting control
				*	*					Overrun cut-off
		*	*	*	*					Engine-speed adjustment, CO adjustment

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 168

Test step	Switch V	Ω	Term.	Checking of components/operation	Test instructions/ test conditions	Set values
1	 V	5	8 - 5	Resistance, temperature sensor (engine)	Connect control-unit plug only Engine temperature +15...+30 °C: approx. +80 °C:	1.45...3.3 k Ω 280...360 Ω
2	 V	6	4 - 5	Ground of output stage		0...10 Ω
3	-	-	-	Not applicable		
4	 V	9	15 - 5	Resistance of throttle- valve switch (idle)	Pull off plug from spark-advance mechanism Throttle valve closed: Throttle valve open :	0...10 Ω infinite Ω
5	 V	10	14 - 5	Resistance of throttle- valve switch (full load)	Plug remains disconnected Throttle valve closed : Throttle valve fully open:	inifinite Ω 0...10 Ω
6	5	10	1 - 5 (+) (-)	TN signal from spark- advance mech. term.5	Connect plug onto spark-advance mechanism Transmission in neutral position, start engine	Rectangular pulse on oscilloscope
7	6	10	2 - 5 (+) (-)	Voltage supply of control unit	Switch on ignition	8...15 V
8	7	10	12 - 5 (+) (-)	Winding term. 85b/87 of double relay	Switch on ignition	8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (continued)

Adapter lead: 1 684 463 168

Test step	Switch V	Ω	Term.	Testing of components/operation	Test instructions/ test conditions	Set values
9	7	10	12 - 5	Simulation, activation of electric fuel pump	Pull off lead plug from auxiliary-air device Switch on ignition Press test button 3	Electric fuel pump running, check by listening
9.1	7	10	12 - 5	Simulation, activation of auxiliary-air device	Connect lead plug onto auxiliary-air device Switch on ignition Press test button 3	Restriction closes air-gap area, visual examination
10	7	10	12 - 5 (+) (-)	Ground connection of double relay term.85b via control unit	Connect control unit too Transmission in neutral position, start engine Operate engine at idle speed	0...5 V
11	8	10	11 - 5 (+) (-)	Air-flow signal UP output term.11	Leave engine running	0...5 V depending upon load
12	-	-	-	Not applicable		
13	10	10	3 - 5 (+) (-)	Injection pulses from control unit	Leave engine running	Injection pulses on oscilloscope
14	11	10	10 - 5 (+) (-)	Load signal TL output term.10	Leave engine running	TL rectang. pulses depending upon load
15	12	10	9 - 5 (+) (-)	Reference voltage UV output term.9	Leave engine running	3.5...4.5 V
16	10	10	3 - 5 (+) (-)	Simulation, engine cold	Leave engine running, press test button 1	Injection pulse wider or engine speed lower

RAPID DIANOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (continued)
 Adapter lead: 1 684 463 168

Test step	Switch		Term.	Testing of components/operation	Test instructions/ test conditions	Set values
	V	Ω				
17	10	10	3 - 5 (+) (-)	Simulation, engine warm	Leave engine running, press test button 2	Injection pulse must not become wider
18	10	10	3 - 5 (+) (-)	Simulation, overrun cut-off	Leave engine running, engine speed above 2000 min ⁻¹ Press test button 5	No injection pulse, engine hunts
19	10	10	3 - 5 (+) (-)	Simulation, full-load adjustment	Leave engine running, engine speed approx. 2200 min ⁻¹ Press test button 6	Low injection pulse and/or change of engine speed.

TEST SPECIFICATIONS

Components/operation	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 625 cm ³ /30 s
* Supply voltage under load:	at least 12V
Pressure regulator	
* Fuel pressure with engine not running:	2,3...2,7 bar
at idle speed:	approx. 0.5 bar lower
Fuel system, leakage	
* Fuel pressure 20 min. after engine switched off:	at least 1.0 bar
Auxiliary-air device	
* Internal elec. resistance:	30...65 Ω
Air-flow sensor, only measurable if control unit is removed.	
* Resistance value between term.3- and term.4- :	500...1000 Ω
term.3- and term.2- :	
Air-flow sensor flap in rest position	10...200 Ω
When air-flow sensor flap is deflected, indication must change:	
Temperature sensor (intake air), only measurable if control unit is removed.	
* Internal electrical resistance, between term.3- and term.1-, at ambient temperature +15...+30 °C:	1.45...3.3 k Ω

Test specifications (continued)

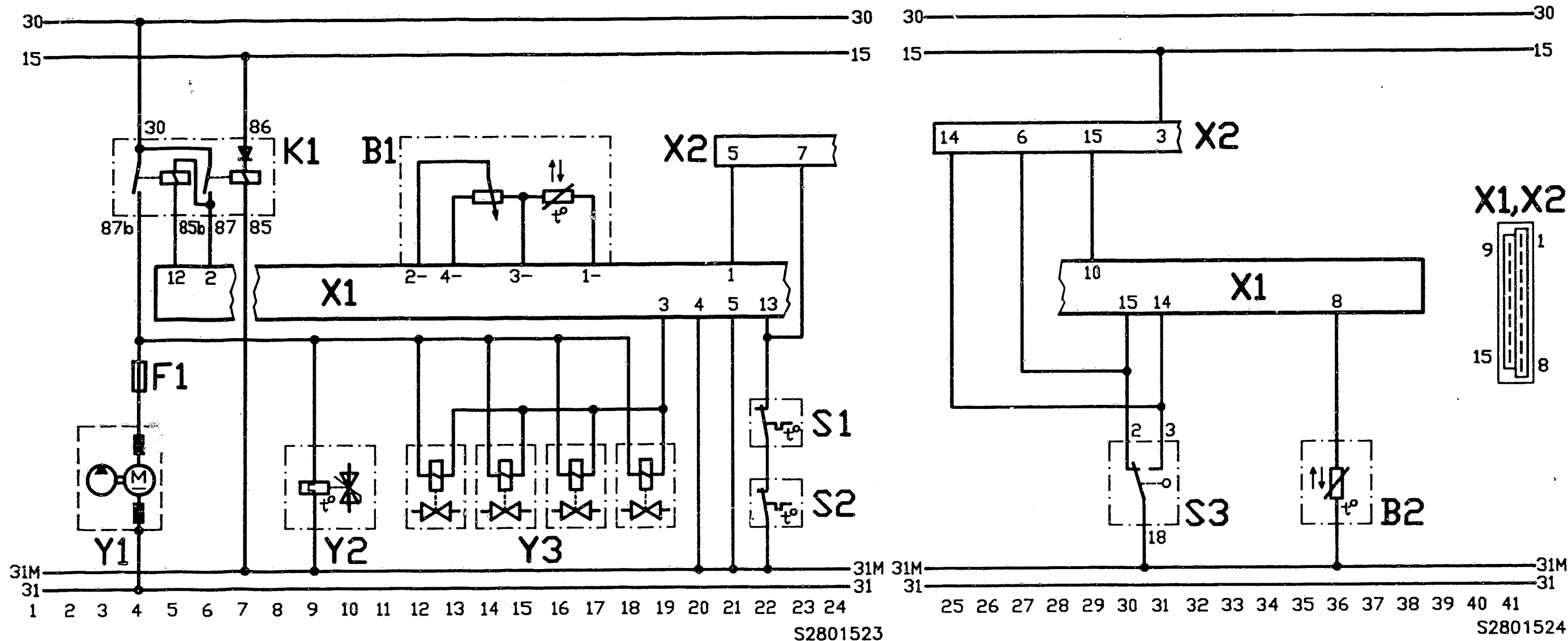
Component/Function	Set values
Temperature sensor (engine)	
* Internal resistance at ambient temperature +15...+30 °C :	1.45...3.3 k Ω
with engine at operating temp. approx. +80 °C :	280...360 Ω
Solenoid-operated injection valve	
* Internal resistance at ambient temperature +15...+30 °C :	14,5...17,5 Ω
* Leakage after 60 s:	No droplets may drip off
Start control	
* Voltage at injection valve Start initiation:	approx. 1.5 V
After approx. 15 s:	approx. 0.5 V
Temperature switch (engine oil)	
* Resistance less than approx. 65°C:	approx. 0 Ω
above approx. 65°C:	infinity Ω
Temperature switch (intake air)	
* Resistance below approx. 17°C:	infinity Ω
above approx. 17°C:	approx. 0 Ω
Idle-speed adjustment	
Engine at operating temperature, approx. +80°C	
* Idle speed:	900...950 min ⁻¹
* CO content:	0,1...0,5 vol %

Test specifications (continued)

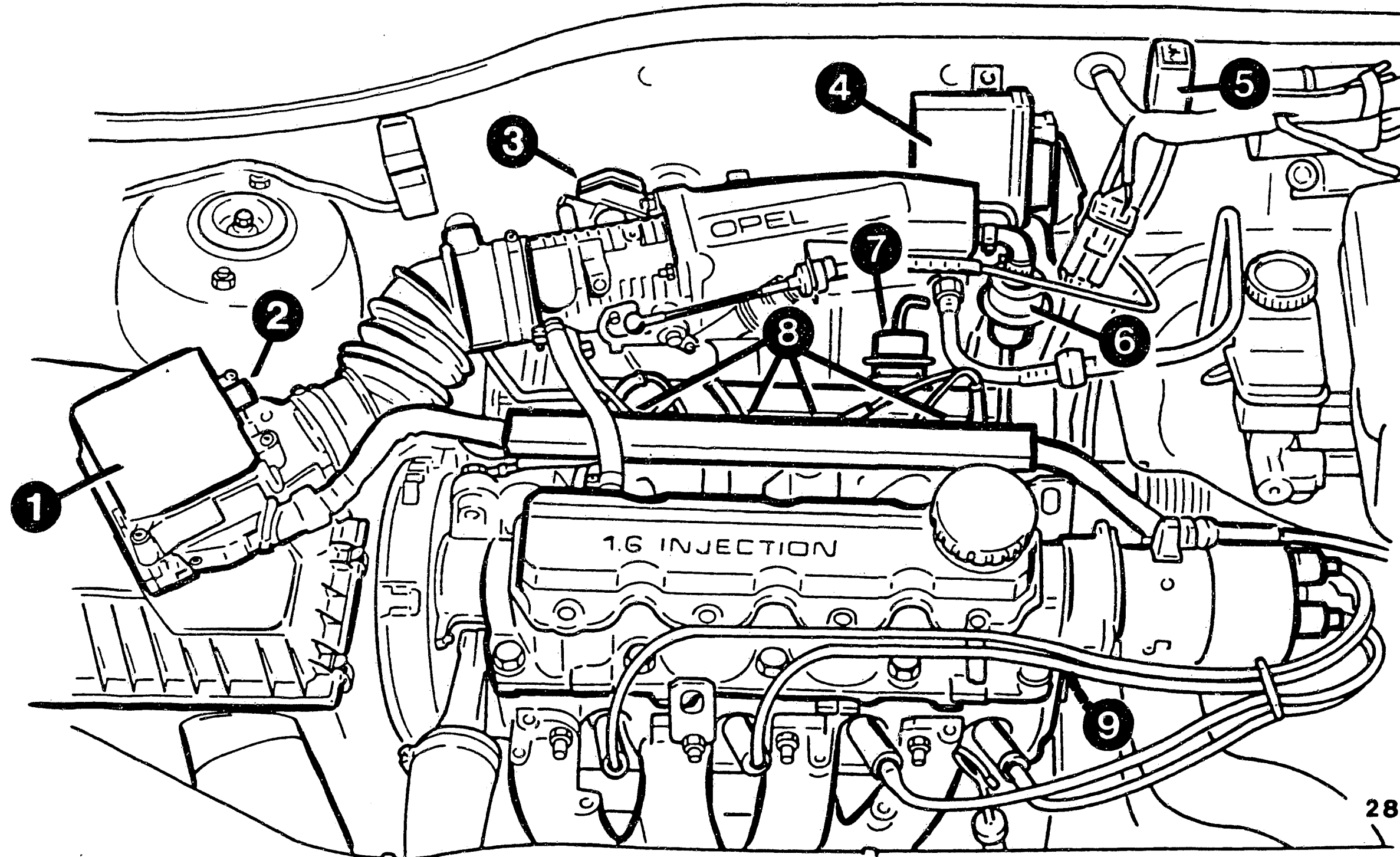
Component/Function	Set values
Overrun air valve (vacuum limiter)	
* Switching point at	approx. 630 mbar

Please refer to equipment and Autodata microcard for settings as regards ignition, valve clearance and other engine-related data.

For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM



280 / 1525

- 1 = Measurement and control facility comprising: air-flow sensor and control unit
- 2 = CO adjustment potentiometer
- 3 = Throttle-valve switch

- 4 = Ignition control unit
- 5 = Twin relay
- 6 = Overrun air valve (vacuum limitation)

- 7 = Pressure regulator
- 8 = Solenoid-operated injection valve
- 9 = Temperature sensor (engine)

INSTALLATION POSITION OF COMPONENTS

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The installation locations always refer to the direction of travel.

* Top picture

Arrow = Temperature sensor (engine)

The temperature sensor is attached beneath the ignition distributor.

* Centre picture

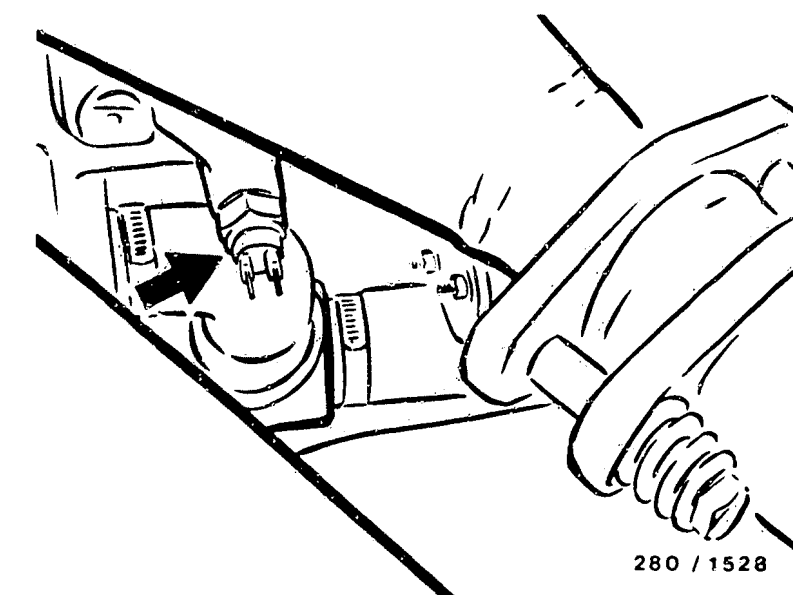
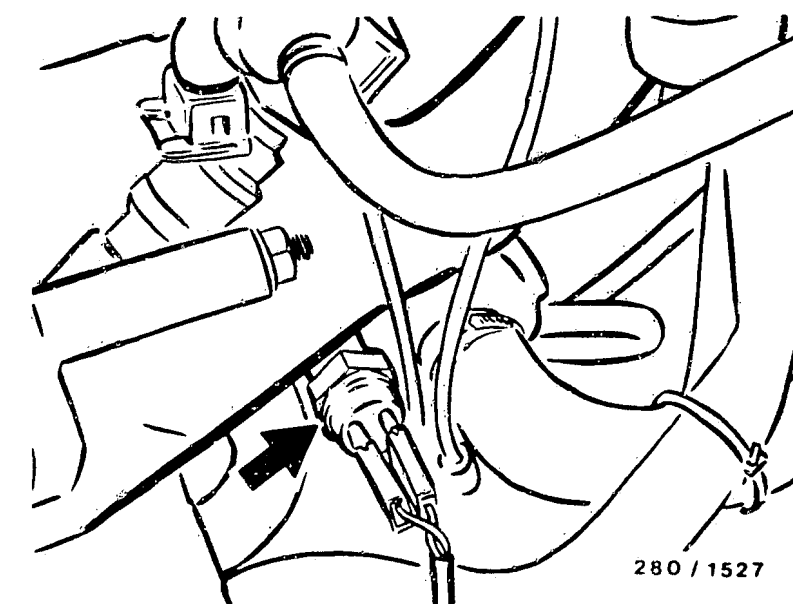
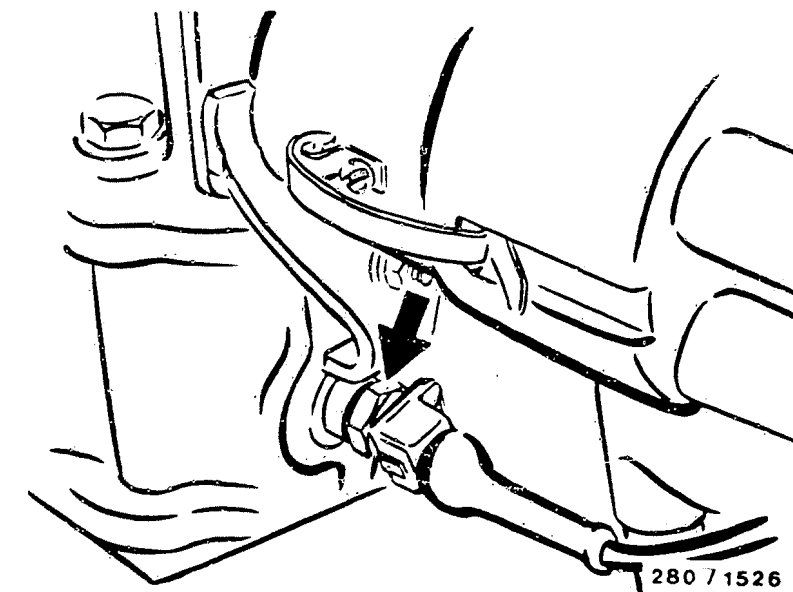
Arrow = Temperature switch (intake air)

* Bottom picture

Arrow = Temperature switch (engine)

The auxiliary-air device is screwed to the engine block in the vicinity of the toothed belt.

The electric fuel pump and the pressure damper are attached to the bottom of the veh. on the right-hand side in front of the rear axle.



Trouble-shooting instructions : AUD-5005
BOSCH system : K-Jetronic
Make of vehicle : Audi 90
Basic microcard : AUD-01/J2

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<u>Section</u>	<u>Coordinates</u>
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Idle stabilization and overrun cut-off.....	15
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SPECIAL FEATURES

* These instructions contain the K-Jetronic trouble-shooting instructions, valid at the time of publication, for the following Audi models:

Audi 90 Quattro, Coupé, Coupé Quattro
Engine KV, HY / 2.3 l / 5 cyl.
10.85->

- * Updraft mixture-control unit
- * Injection valves with air shrouding
- * Warm-up regulator for intake-manifold-pressure-dependent full-load enrichment.
- * Impulse relay for activation of the cold-start valve during warm starting.
- * Pressure-surge switch for acceleration enrichment
- * Overrun cut-off and idle stabilization

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

For testing the compression, disconnect pump relay in order to prevent undesired injection by the injection valves.

Important information with regard to working on the K-Jetronic.

If any fuel connections are loosened or components removed, also from the vacuum system, always use new seals when re-connecting or remounting.

When working on the K-Jetronic, be sure to keep everything clean. Clean the external areas of the fuel connections thoroughly before loosening them.

While testing with the electric fuel pump running, never deflect (lift) the air-flow sensor plate, since this leads to fuel being injected via the injection valves. This can lead to serious damage to the engine when it is started subsequently.

TROUBLE-SHOOTING CHART

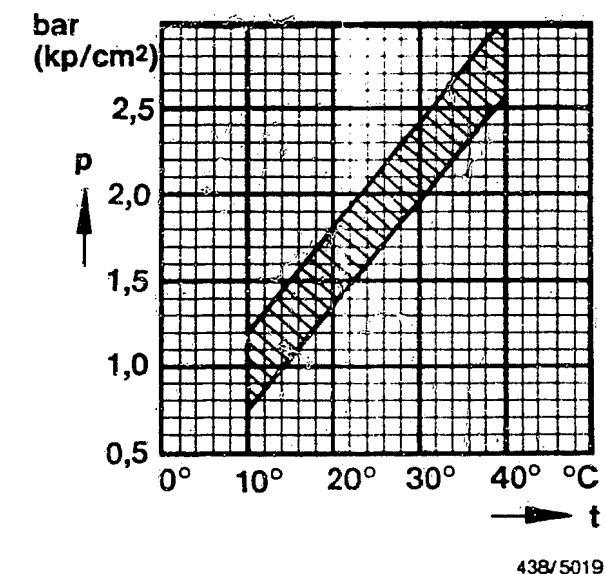
Customer complaint (symptoms of trouble)

- Starting motor operates, but engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Rough idling (engine speed, exhaust gas).
- Poor throttle response, flat spot during acceleration.
- Engine misfiring (ignition, fuel injection).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking
- Engine overheating.
- Fault lamp.

Cause (component fault)										
*	*			*						Electric fuel pump
*		*	*	*						Intake system
*										Fuel system
*		*	*	*	*					Fuel distributor
*		*	*	*	*	*				Air-flow sensor
*		*				*	*			Cold-start system
*		*	*	*		*				Injection valves
	*		*	*	*					Primary pressure
*	*	*	*	*	*	*				Control pressure
*		*	*	*	*					Fuel dispersion
				*						Throttle valve
*	*	*	*	*	*	*				Overrun cut-off
*		*								Idle stabilization
*		*	*	*		*	*			Idle-speed adjustment

For production reasons:
continued on the following
coordinate.

TEST SPECIFICATIONS

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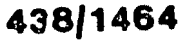
p = Control pressure (gauge pressure)
t = Ambient temperature

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Set value	
6	Injection valves - opening pressure: Leakage test not below 3,5 bar: No drop must fall within 25 s.	3,7...4,8 bar	
7	Fuel delivery - comparative measurement: Idle: Part-load: Full-load: Minimum delivery at max. air-flow sensor plate deflection:	Setting point: (cm ³ /min)	Max. allowable delivery (cm ³ /min)
		6,0 40,0 122	6,6 42,8 134
		122 cm ³ /min	
8	Thermo-time switch - resistance measurement: Terminal G and ground: Terminal W and ground: Terminal G and terminal W:	below + 30° C 50...70 Ω 0 Ω 50...70 Ω	above + 40° C 50...70 Ω infinity Ω infinity Ω
9	Idle-speed adjustment* Idle speed: CO content:	750...850 min ⁻¹ % by vol. 0,8...1,2	

* Notes on idle-speed adjustment:

The idle speed cannot be adjusted. If necessary, see the basic instructions for testing the idle stabilization.
Engine-oil temperature at least 80 °C.
Hose for crankcase ventilation disconnected and positioned so that only fresh air can be inducted.
All electrical consuming devices switched off.
The radiator fan must not operate.



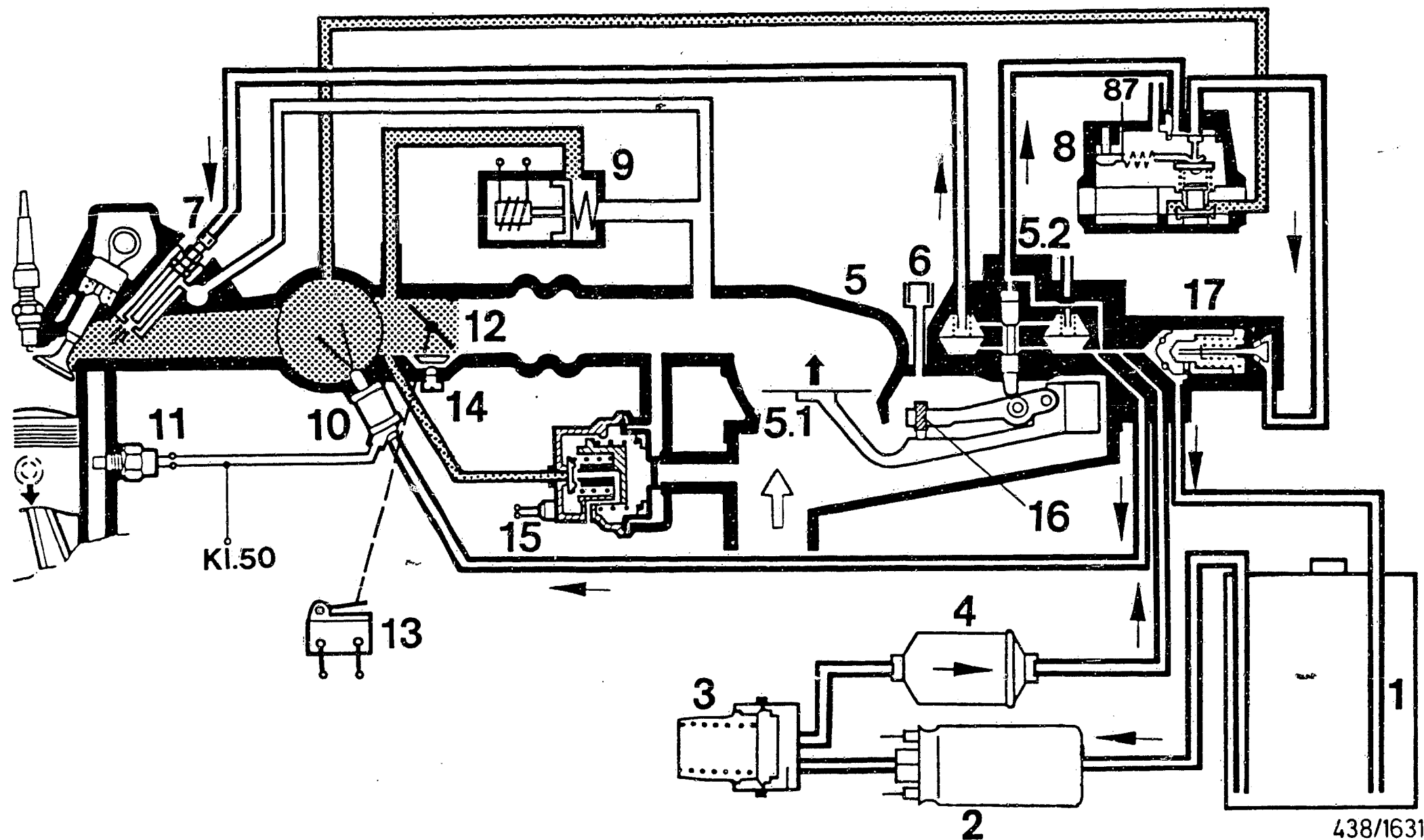
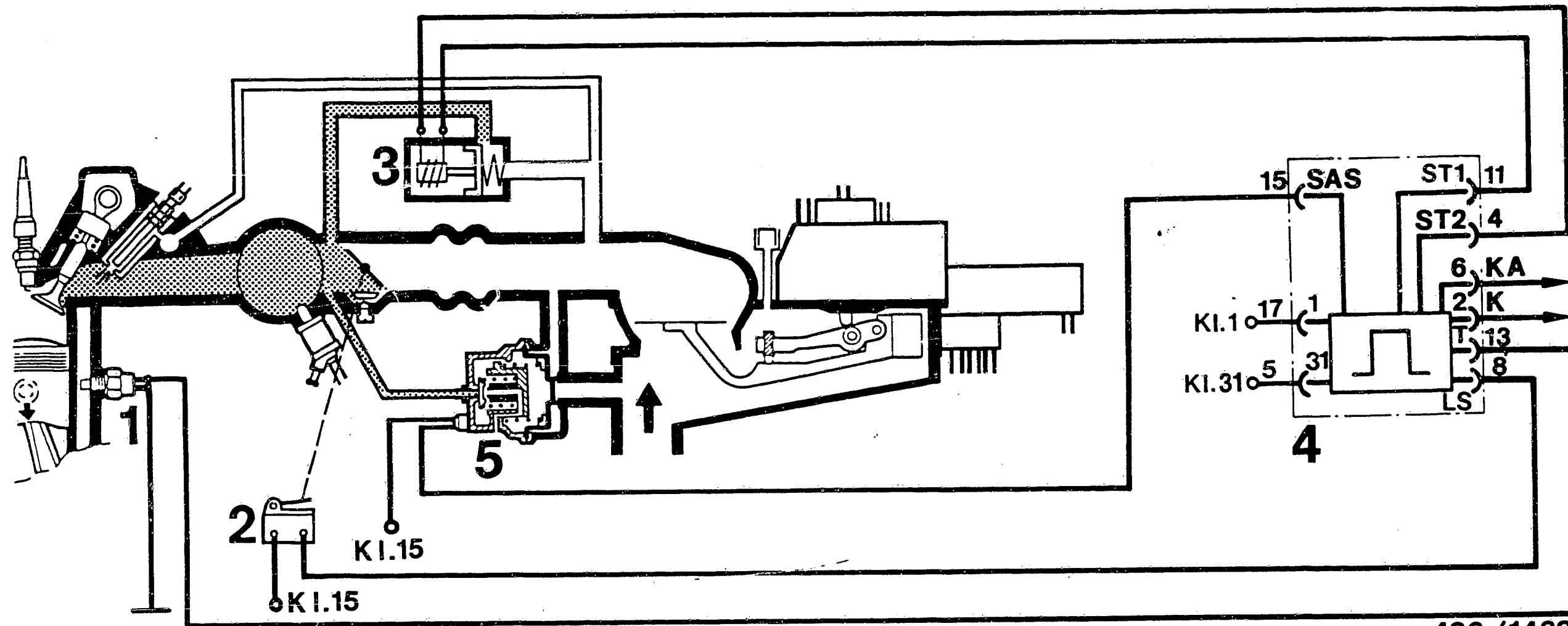


DIAGRAM OF AIR/FUEL LINES

- 1 = Fuel tank
- 2 = Electric fuel pump
- 3 = Fuel accumulator
- 4 = Fuel filter
- 5 = Mixture-control unit
- 5.1 = Air-flow sensor
- 5.2 = Fuel distributor
- 6 = Fuse cap
- 7 = Injection valve
- 8 = Warm-up regulator

- 9 = Idle actuator
- 10 = Cold-start valve
- 11 = Thermo-time switch
- 12 = Throttle valve
- 13 = Throttle-valve microswitch
- 14 = Idle-speed bypass screw
- 15 = Overrun-cutoff valve
- 16 = Idle-mixture-adjusting screw
- 17 = Primary-pressure regulator with push valve



1 = Thermo-switch
 2 = Throttle-valve microswitch
 3 = Idle actuator

4 = Control unit for idle stabilization
 and overrun cut-off
 5 = Overrun-cutoff valve

IDLE STABILIZATION AND OVERRUN CUT-OFF (NON-BOSCH PRODUCT)

The control unit for idle stabilization and overrun cut-off is located on the auxiliary-relay plate beneath the switchboard on the left.

Operating principle, idle stabilization

The idle speed is stabilized by the electronic control unit and the idle actuator. Instead of the auxiliary-air device which is usually fitted, the idle actuator is installed in the air bypass to the throttle valve.

The tractive electromagnet of the idle actuator is supplied with a variably pulsed voltage at a constant frequency by the control unit. In this way, the screen in the air duct is adjusted and the air throughflow changed.

OPERATING PRINCIPLE, OVERRUN CUT-OFF

The control valve of the overrun-cutoff valve is connected to term. 15 and to term. 15 /SAS (overrun cut-off) of the control unit.

The control valve is connected to ground via term. 15/SAS of the control unit under the following conditions:

- * The coolant temperature is above +30°C.
- * The engine speed is greater than 1200 min⁻¹.
- * The throttle-valve switch is in the idle position.

If these conditions are fulfilled, the overrun-cutoff valve opens the air-bypass duct.

INSTALLATION POSITION OF COMPONENTS

- * Electric fuel pump, fuel accumulator, fuel filter:
On vehicle floor panel above the rear axle.
- * Electronic relay:
In the central electrics on the left beneath the instrument panel.
- * Idle-speed increase valve:
In the engine compartment on the firewall next to the battery.
- * Pressure-surge switch:
In the engine compartment on the firewall next to the ignition coil.

Trouble-shooting instructions : AUD-5013

BOSCH system : ABS

Make of vehicle : AUDI

Basic microcard : PKW-040

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SPECIAL FEATURES

This microcard, valid at the time of publication, contains trouble-shooting instructions for the following models:

AUDI 80, 90, (in USA AUDI 4000)
AUDI 100, 200 (in USA AUDI 5000)
AUDI Coupe
as of approx. 8.86

* ABS with 4 wheel-speed sensors and 4 hydraulic channels.

STRUCTURE, USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

Please refer to basic instructions for a detailed description of trouble-shooting.

NOTE :
The set values, terminal assignments and special features in these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- * For safety reasons, the hydraulic modulator must never be repaired, but rather only replaced as a complete unit.
Exception: Relay.
- * Never loosen any screws on hydraulic modulator!
Such a course of action could lead to fatal brake failure.
- * Take care when handling brake fluid.
Toxic!
- * A limited brake test is permitted, but no performance test.

Refer to basic instructions for further information.

PREREQUISITES FOR TESTING WITH ABS 2-TESTER

- * Specified tire size fitted?
- * Test tightness of ground connection of return pump.
- * Test tightness of ground connection of Combi relay term. 31 and watch out for corrosion.
- * Test tightness of ground strap between engine block and vehicle frame.
- * Test hydraulic connections at hydraulic modulator and sealing points for leakage (visual inspection).
- * If the ABS warning lamp lights up sporadically when driving (e.g. after switching on loads) and goes out again of its own accord, test battery and voltage supply (alternator, regulator and voltage dips).
- * If ABS warning lamp is constantly lit and does not go out, check following items:
 - Is controller plug properly attached to controller and engaged?
 - All plug contacts O.K.?
 - Spring contacts engaged?
 - Check for proper seating of sealing ring in controller plug:
Curvature downwards.
 - Test wheel-speed-sensor leads at controller plug for correct assignment:

Wheel-speed sensors:

Front left to term. 5 and term. 4.
Front right to term. 23 and term. 11.
Rear left to term. 7 and term. 9.
Rear right to term. 24 and term. 26.
Rear axle to term. - and term. -.

Wheel-speed sensor:

in Audi 80, 90, 100, 200 as of approx. 1.88 front right at term.11 and term.21.

- V-belt snapped?
(No voltage supply from alternator, charge and ABS warning lamp light up).
- * Connect ABS2-LED tester to ABS wiring harness.
- Only detach and connect controller with ignition off.
- For test purposes, switch on ignition in all program-selector-switch settings (tester uses power supply from vehicle battery).
- Observe LED (green) for power supply in all program-selector-switch settings.

C A U T I O N !

Never drive with tester connected!
Brake system must be bled before performing ABS test. Do not actuate ABS tester during bleeding process.
The entire test program is to be repeated whenever repairs have been performed.
The ABS system is a vehicle safety system.
Work on this system presupposes detailed system knowledge.
The conventional brake system must be in proper working order.

General information on trouble-shooting:

Test all leads for short-circuit to ground and contact with positive leads as well as being on the lookout for worn insulation and squashed leads.

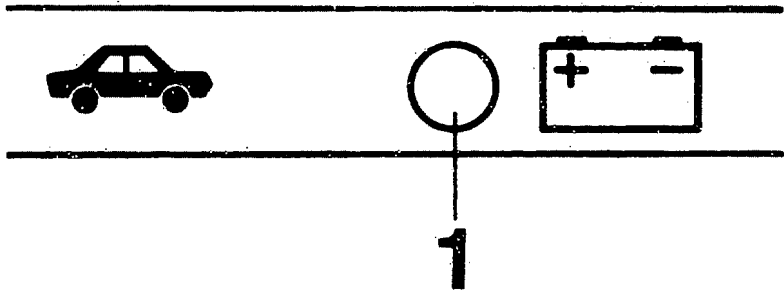
RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

Program-selector-switch settings 1 to 6

ABS button switched on, lock button switched off

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply (term. 1 and term. 20)	Ignition on	LED 1 (top picture) lights up all the time	<ul style="list-style-type: none">* Inadequate battery charge* Excessive voltage drops* Combi relay defective* Test lead to driving switch term. 15.

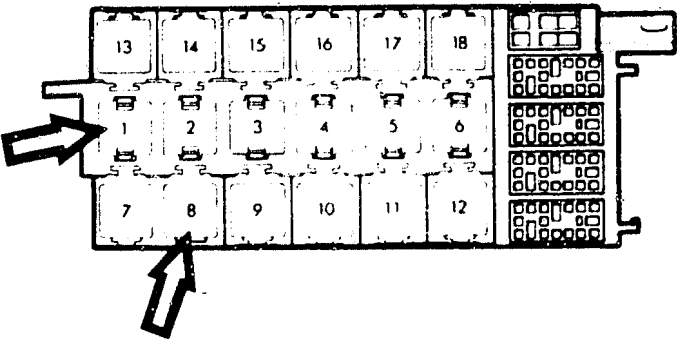


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Arrows = Combi relay in
auxiliary relay holder

Relay position 1 in
80/90 quattro

Relay position 8 in 100/200
quattro

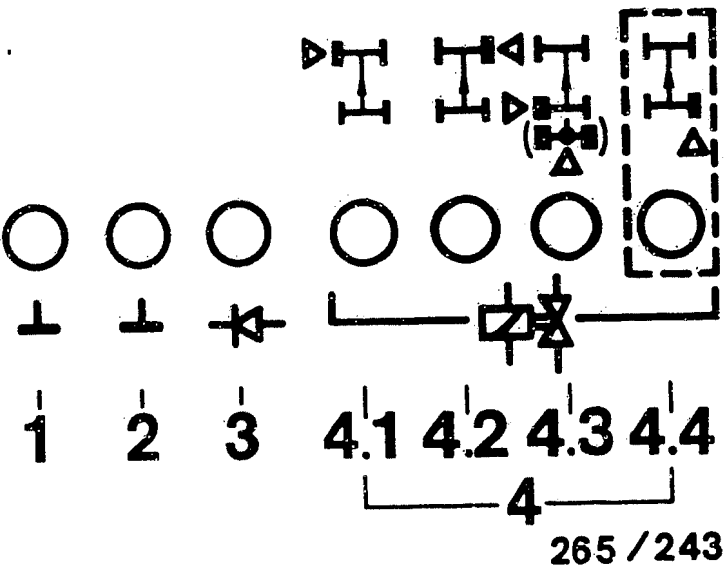


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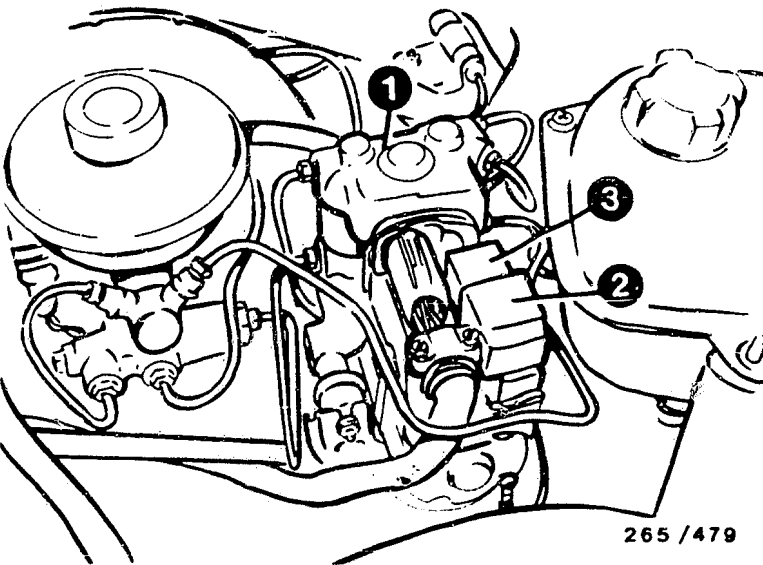
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.35, term.18, term.19) Off-position and ground connection of relay ABS warning lamp	Ignition on	7 LED (1 to 4.4) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads.Solenoid-operated valve internal resistance 0,7...1,7 Ω* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.* ABS warning lamp not lit: Warning lamp defective. Note: all other 7 LEDs lit.



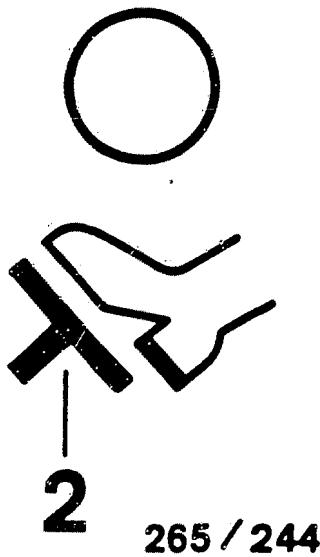
- 1 = Hydraulic modulator
- 2 = Motor relay
- 3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

Under test (Measurement at the terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

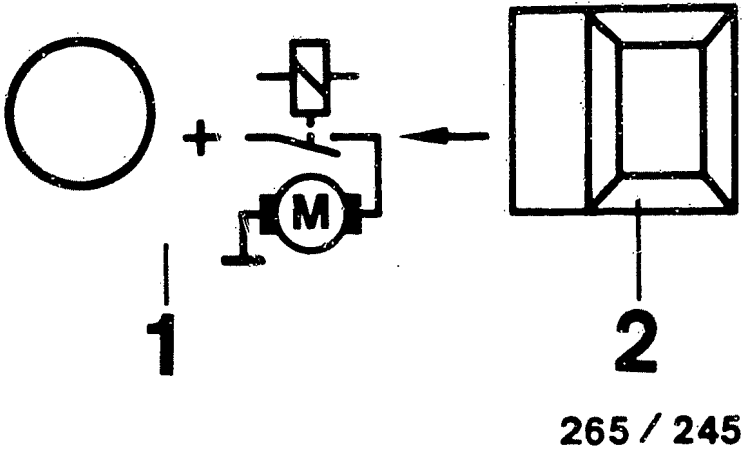


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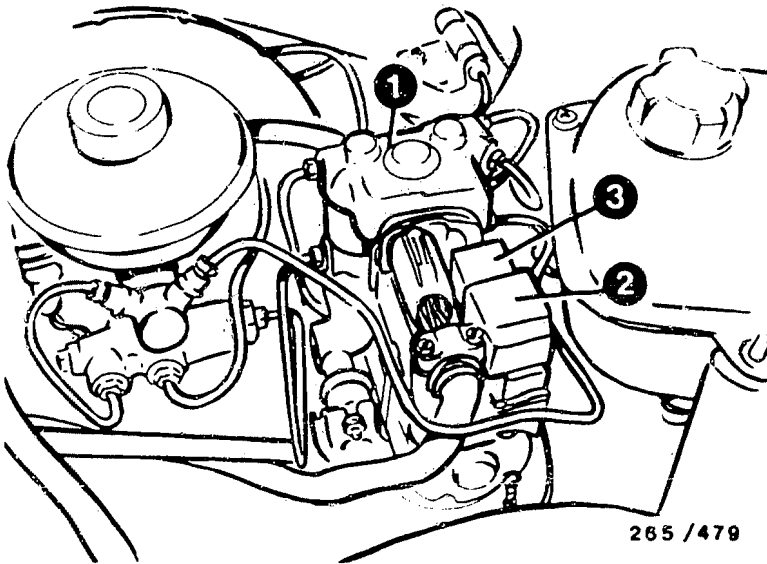
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 3

Testing of (measurement at terminals)	Additional operation	Test specifi- cations (reading)	Possible causes of faults
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, Press button 2 continuously (top picture)	LED 1 lit, pump motor running. After button is released, LED continues to light due to running-on of motor (top picture).	<ul style="list-style-type: none">* Motor relay defective* Check ground connection and positive terminal of hydraulic modulator* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 and term. 11.* Pump motor defective

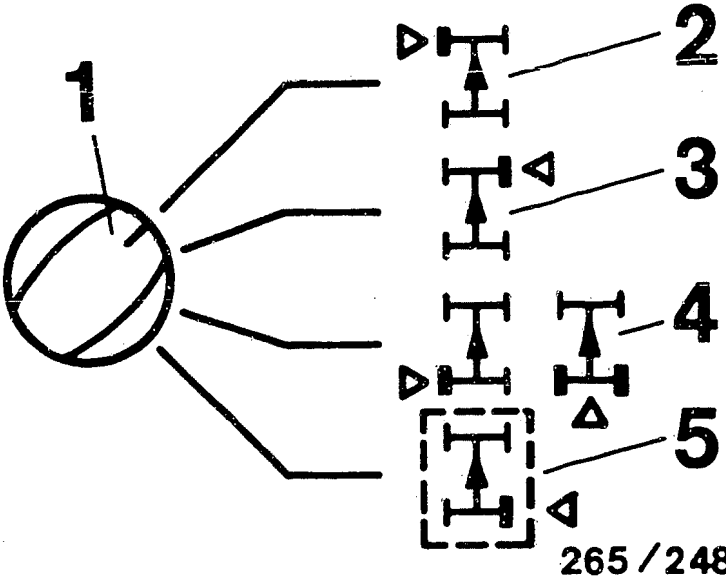
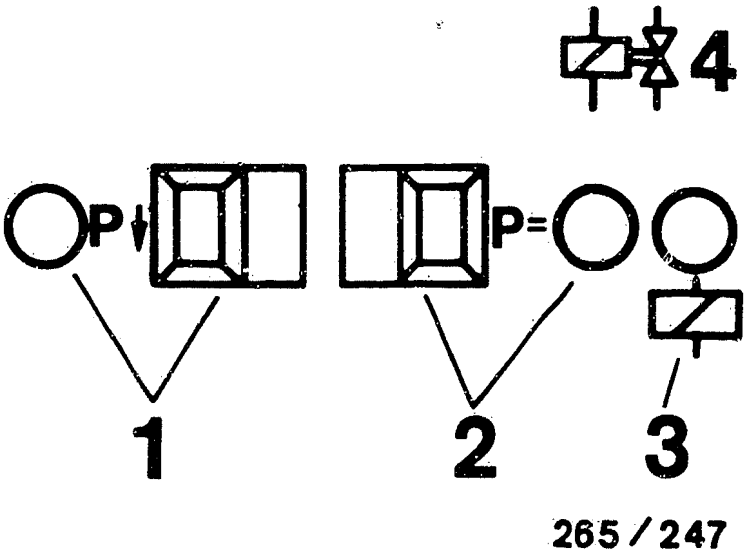


1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch position 5 (3-channel hydraulic modulator)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay opera- tion (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running * Valve relay (make contact) defective * Break in line from valve relay term. 87 to batt. +ve * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push- button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push- button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push- button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correct- ly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.18 Wheel, rear right: term.19 Rear axle: term.- * Hydraulic modulator defective
	5.Release push- button P arrow (upper illustration)	LED P arrow (upper illus- tration) goes out, wheel locks	
	6.Release brake pedal		

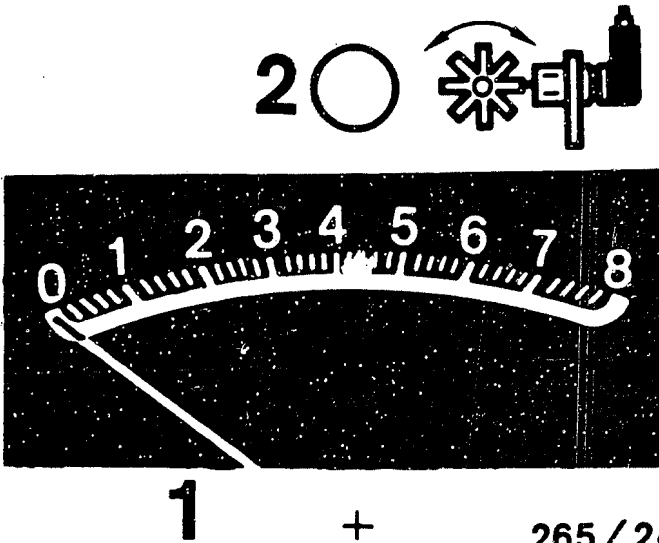
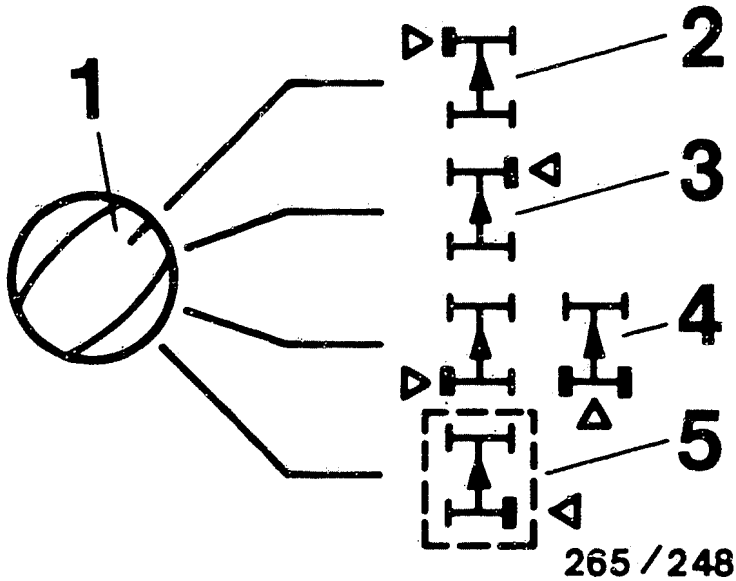


RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch setting6 (4 wheel-speed sensor)

Testing of (Measurement at terminals)	Additional operation	Test spec. (Indication)	Possible causes of fault
Wheel-speed sensor for proper func- tioning and mix-up NOTE: Perform test con- secutively for each individual wheel. Front left wheel: Term.5 + term.4 Front right wheel: Term.23 + term.21 with 80/90/100/200 as of approx. 1.88 Term.11 + term.21 Rear left wheel: Term.7 + term.9 Rear left wheel: Term.24 + term.26	Jack up vehicle. Ignition on. It must be possible to turn the wheel to be tested freely by hand. The wheel not being tested must be held when testing the driven axis. Set switch for wheel selection to wheel to be tested (bottom picture) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 revolution per second). Then take reading from instrument: (Top picture)	1.Smallest reading greater than1,0 scale divisions 2.Smallest reading greater than 1,6 scale divisions 3.Permissible fluctuation span max. 25 % of highest value indicated	*Wheel-speed-sensor lead mixed up *Open-circuit in wheel- speed-sensor lead *Wheel-speed sens.defect. Winding resistance Front and rear axle: 0,6...1,6 k Ω *Excessive air gap between wheel-speed sensor and ring gear *Ring gear defective or loose *Ring gear fitted has in- correct number of teeth Front axle: 96 teeth Rear axle: 96 teeth For Audi 80/90/100/200 as of approx. 1.88 Front axle: 45 teeth Rear axle: 45 teeth *Exc.wheel-bearing play *Reading provided, LED 2 does not light up: Loose contact in wheel- speed-sensor lead.

Continue testing on next coordinate.



TEST SPECIFICATIONS

Wheel-speed sensor		
* Winding resistance at ambient temperature (-10°C...+120°C) for front axle:	600...1600	Ω
rear axle:	600...1600	Ω

Hydraulic-modulator solenoid valves		
* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7	Ω

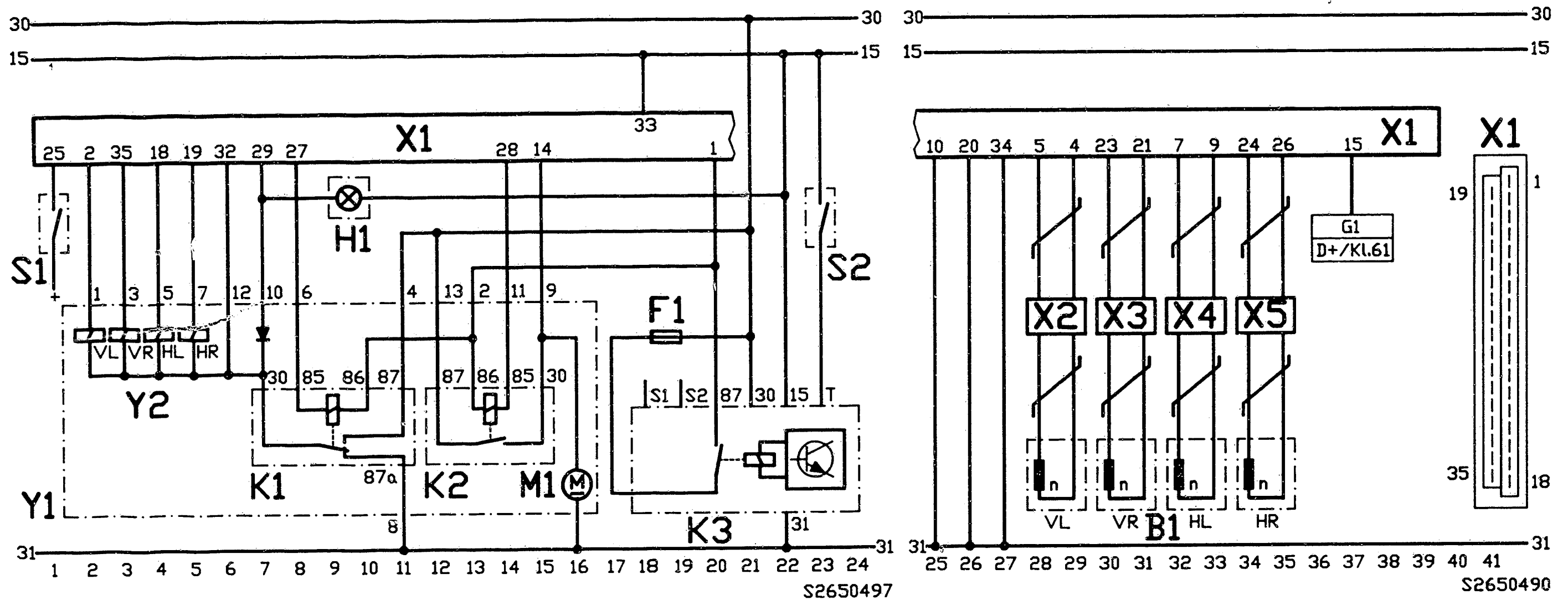
Air gap	0,8 ±0,5	mm
* Automatically adjusted if use is made of a new cap (part no. 3 330 508 012).		

Tightening torque for		
* fastening screws of wheel-speed sensors:	> 8	Nm
* brake-line connections at hydraulic modulator:	12...16	Nm

Number of teeth		
* Front axle:	96	teeth
* Rear axle:	96	teeth

For AUDI 80, 90, 100, 200 as of approx. 01.88		
* Front axle:	45	teeth
* Rear axle:	45	teeth

For production reasons:
continued on the following
coordinate.

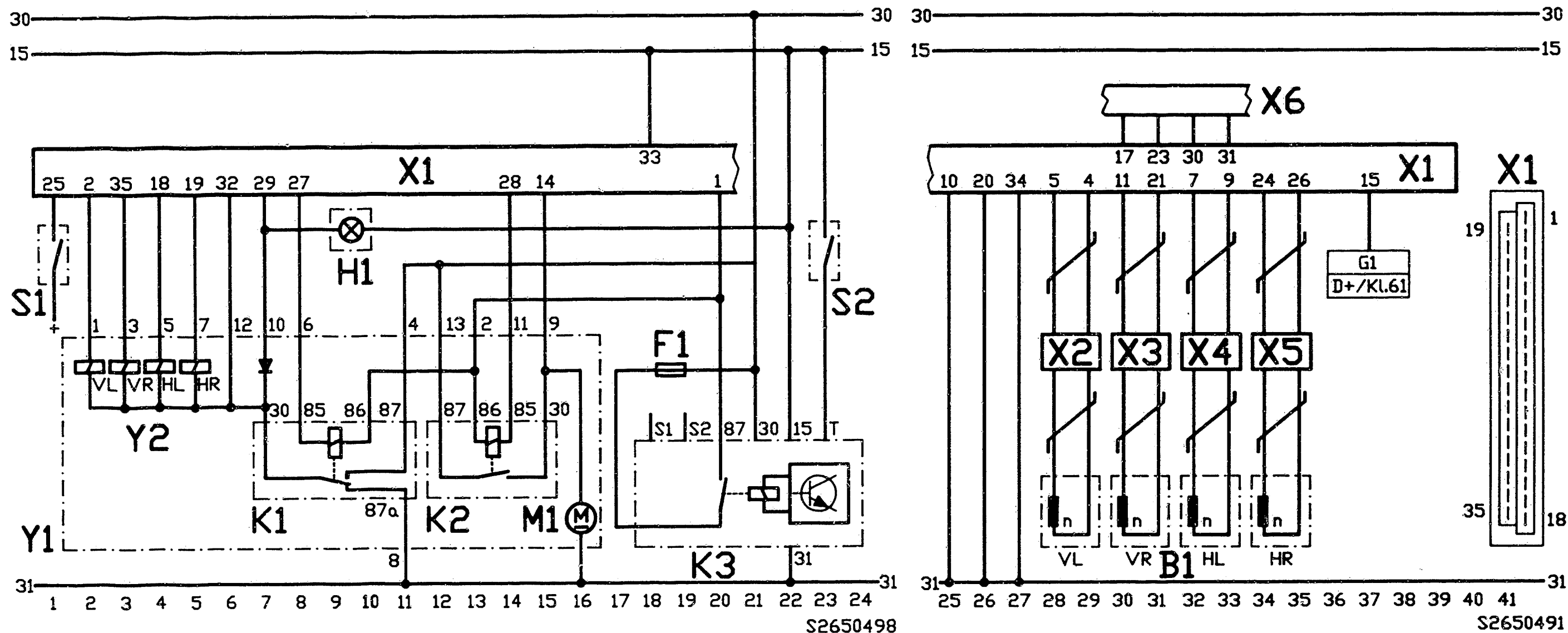


B1 = Wheel-speed sensor
 G1 = to alternator
 H1 = ABS warning lamp
 K1 = Valve relay
 K2 = Motor relay
 K3 = Combi relay
 M1 = Return pump motor

S1 = Stop-lamp switch
 S2 = ABS switch
 X1 = Controller plug (35-pole)
 X2...X5 = Multiple butt connector
 Y1 = Hydraulic modulator
 Y2 = Solenoid valve

VL = Front left
 VR = Front right
 HL = Rear left
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM → 1.88



B1 = Wheel-speed sensor
 G1 = to alternator
 H1 = ABS warning lamp
 K1 = Valve relay
 K2 = Motor relay
 K3 = Combi relay
 M1 = Return pump motor

S1 = Stop-lamp switch
 S2 = ABS switch
 X1 = Controller plug (35-pole)
 X2...X5 = Multiple butt connector
 X6 = Plug, wheel-speed-sensor outputs
 Y1 = Hydraulic modulator
 Y2 = Solenoid valves

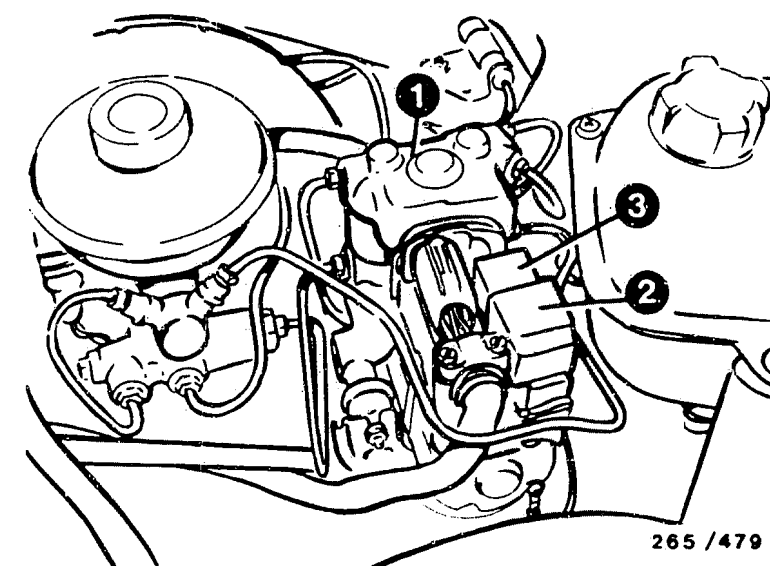
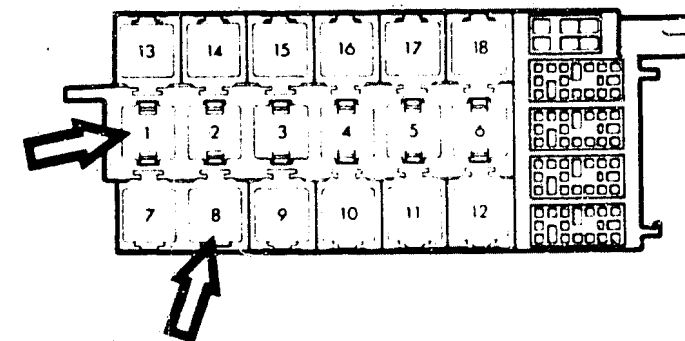
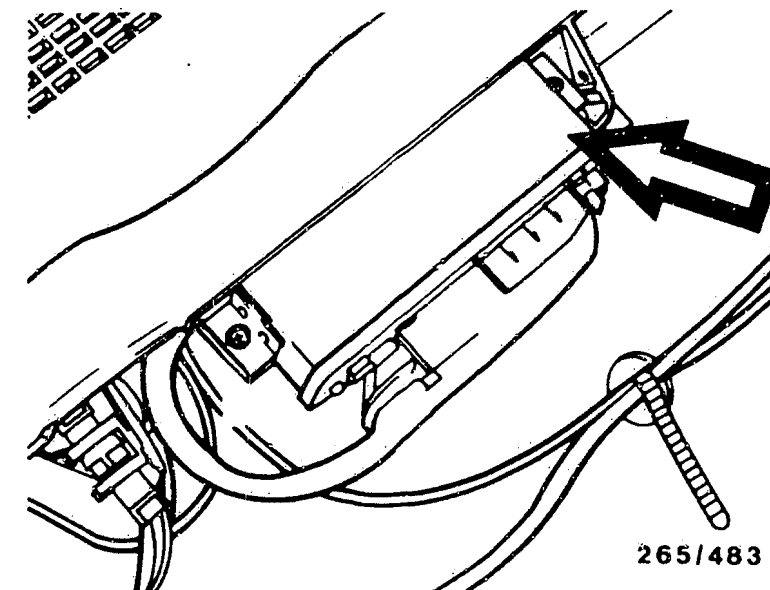
VL = Front left
 VR = Front right
 HA = Rear axle
 HL = Rear left
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM (with additional wheel-speed-sensor outputs) 1.88 ->

INSTALLATION POSITION OF COMPONENTS

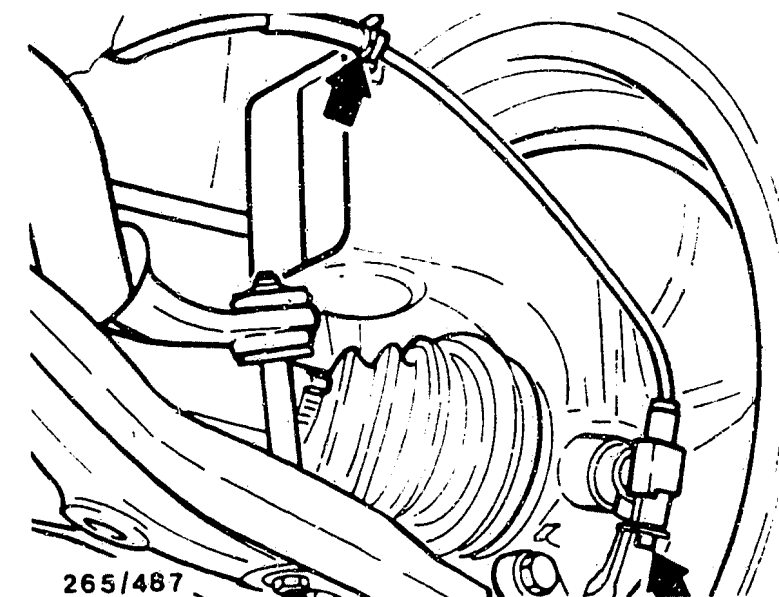
The installation locations always refer to the direction of travel

- * Controller (top picture):
 AUDI 100/200 beneath rear seat bench on left at heel board
 AUDI 80/90 as of 1987 beneath rear seat bench on left
 AUDI 80/90 up to 1987 in trunk on right next to fuel tank
 AUDI Coupe up to 1988 in trunk on right next to fuel tank
- * Stop-lamp switch
 At brake pedal.
- * ABS warning lamp
 In instrument panel.
- * ABS switch
 In instrument panel.
- * Combi relay (centre picture):
 Front left beneath instrument panel, in aux. relay holder
 Relay position 1 in AUDI 80/90 or relay position 8
 in AUDI 100/200
- * Ground terminal for ABS
 AUDI 80/90 behind instrument panel on left
 AUDI 100/200 beneath rear seat bench on right.
- * Hydraulic modulator (bottom picture):
 In engine compartment on left in direction of travel.

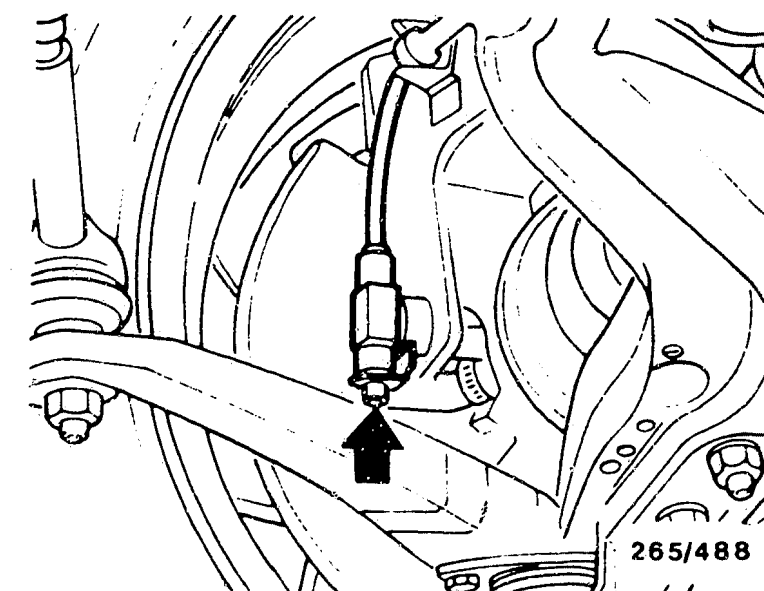


INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Wheel-speed sensor at front axle (top picture):
Attached on inside on right and left in wheel bearing housing.



- * Wheel-speed sensor at rear axle (bottom picture):
One each on left and right at wheel bearing housing.



Trouble-shooting instructions : AUD-5014
BOSCH system : ABS
Make of vehicle : AUDI
Basic microcard : PKW-040

TABLE OF CONTENTS

Section	Coordinates
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Structure, usage	02
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Test prerequisites	03
Rapid diagnosis chart	05
Differential lock	19
Test specifications	20
Electrical terminal diagram	21
Installation position of components, removal and installation instructions	25

SPECIAL FEATURES
This microcard, valid at the time of publication,
contains trouble-shooting instructions for the
following models:

AUDI 80, 90 quattro
AUDI 100, 200 quattro
AUDI quattro
AUDI 4000, 5000 quattro
as of approx. 8.86

- * ABS with 4 wheel-speed sensors and 3 hydraulic channels.
- * Acceleration sensor (a_L) as of mid 1987 with the exception of Audi 4000, 5000 quattro

STRUCTURE, USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

A detailed description of trouble-shooting is given in the basic instructions.

NOTE:
The set values, terminal assignments and special features indicated in these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

- * For safety reasons, the hydraulic modulator is not to be repaired, but rather only replaced as a complete assembly.
Exception: relay.
- * Do not loosen screws on hydraulic modulator!
Brake failure may otherwise be fatal.
- * Take care when handling brake fluid.
Poisonous!
- * A limited brake test is permitted, but no performance test.

Refer to basic instructions for further information.

PREREQUISITES FOR TESTING WITH ABS 2-TESTER

- * Specified tire size fitted?
- * Test tightness of ground connection of return pump.
- * Test tightness of ground connection of Combi relay term. 31 and watch out for corrosion.
- * Test tightness of ground strap between engine block and vehicle frame.
- * Test hydraulic connections at hydraulic modulator and sealing points for leakage (visual inspection).
- * If the ABS warning lamp lights up sporadically when driving (e.g. after switching on loads) and goes out again of its own accord, test battery and voltage supply (alternator, regulator and voltage dips).
- * If ABS warning lamp is constantly lit and does not go out, check following items:
 - Is controller plug properly attached to controller and engaged ?
 - All plug contacts O.K.?
 - Spring contacts engaged?
 - Check for proper seating of sealing ring in controller plug:
Curvature downwards.
 - Test wheel-speed-sensor leads at controller plug for correct assignment:

Wheel-speed sensors:

Front left to term. 22 and term. 4.
Front right to term. 23 and term. 21.
Rear left to term. 8 and term. 9.
Rear right to term. 24 and term. 26.
Rear axle to term. - and term. -.

Wheel-speed sensor:

on Audi 80, 90, 100, 200 -quattro as of approx.
1.88 front right to term. 11 and term. 21.

- V-belt snapped?
(No voltage supply from alternator, charge and ABS warning lamp light up).
- * Connect ABS2-LED tester to ABS wiring harness.
- Only detach and connect controller with ignition switched off.
- For test purposes, switch on ignition in all program-selector-switch settings (tester uses power supply from vehicle battery).
- Observe LED (green) for power supply in all program-selector-switch settings.

I M P O R T A N T !

Never drive with tester connected!
Brake system must be bled before performing ABS test. Do not actuate ABS tester during bleeding process.
The entire test program is to be repeated whenever repairs have been performed.
The ABS is a vehicle safety system.
Work on this system requires detailed system knowledge.
The conventional brake system must be in proper working order.

General notes on trouble-shooting:

Test all leads for short-circuit to ground and contact with positive leads as well as for worn insulation and crushing.

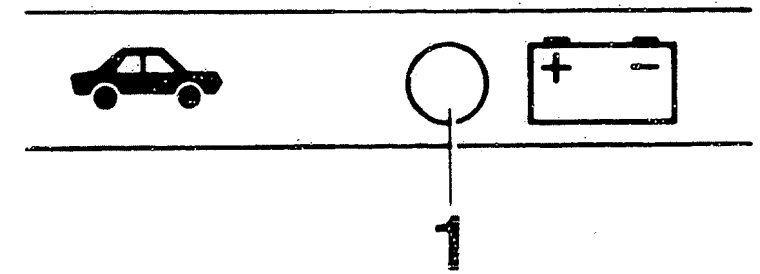
RAPID DIAGNOSIS CHART

Never drive with tester connected! Have all test prerequisites been met?

Program-selector-switch settings 1 to 6

ABS button switched on, lock button switched off

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Voltage supply (term. 1 and term. 20)	Ignition on	LED 1 (top picture) lights up all the time	<ul style="list-style-type: none"> * Inadequate battery charge * Excessive voltage drops * Combi relay defective * Test lead to driving switch term. 15.

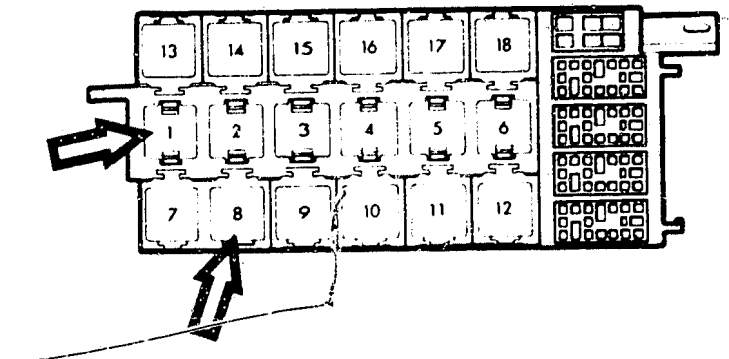


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Arrows = Combi relay in
auxiliary relay holder

Relay position 1 in
80/90 quattro

Relay position 8 in 100/200
quattro

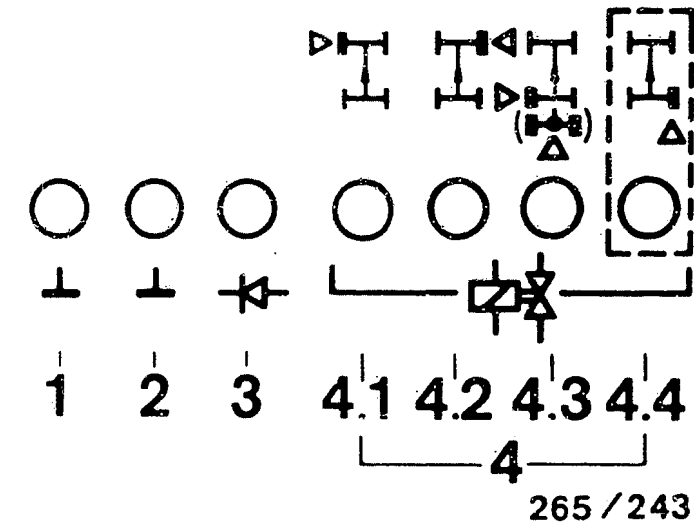


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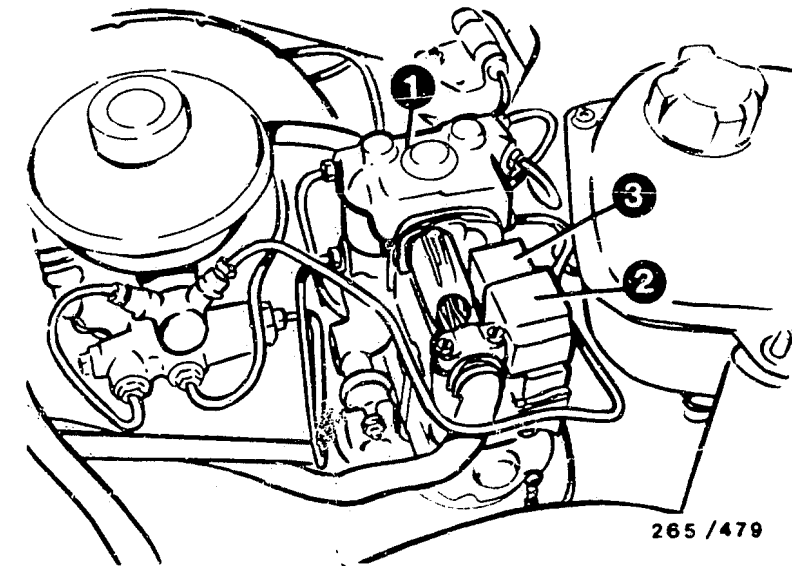
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Addition- al operation	Test specifi- cation (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35) Off-position and ground connection of relay ABS warning lamp	Ignition on	6 LED (1 to 4.3) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	<ul style="list-style-type: none">* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit.* LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay.* One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid- operated valve and leads.Solenoid-operated valve internal resistance 0,7...1,7 Ω* All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective.* Dimmer lighting-up of an LED means contact resistance in the corresponding circuit.* ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.



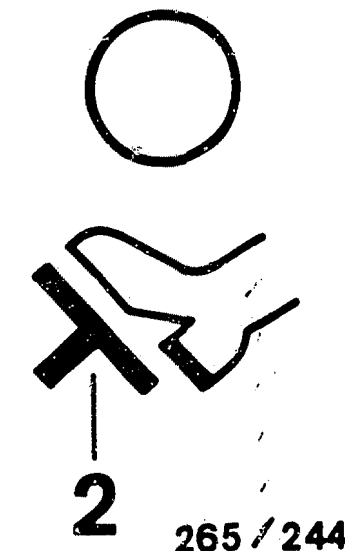
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 2

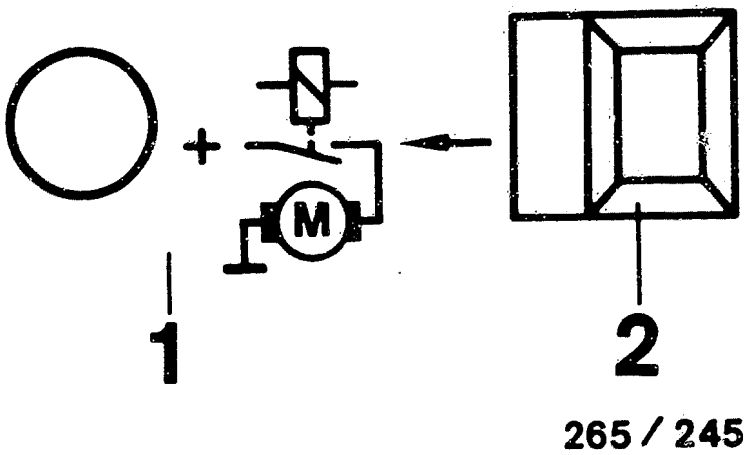
Under test (Measurement at the terminals)	Additional operation	Test specifi- cation (reading)	Possible causes of trouble
Alternator voltage from term. 61/D+ (term. 15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead and signal from alternator term. 61 * Alternator defective.
Stop-lamp switch (term. 25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.



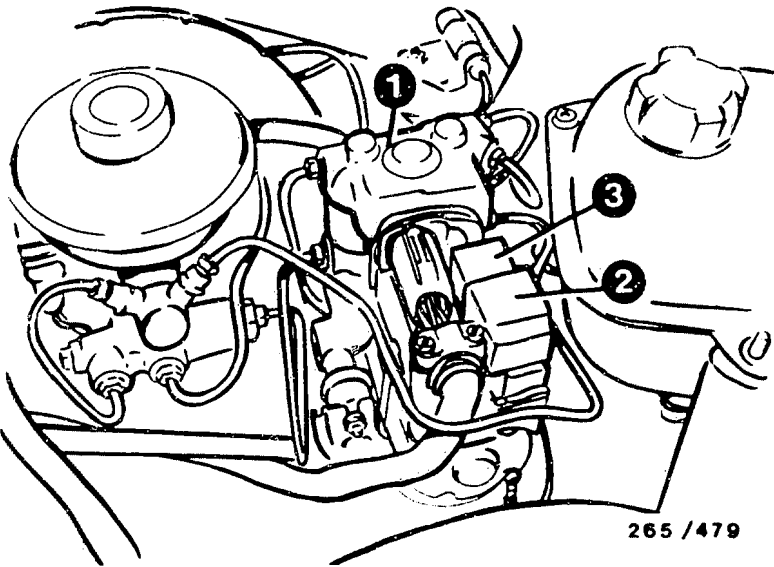
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 3

Testing of (measurement at terminals)	Additional operation	Test specifi- cations (reading)	Possible causes of faults
Motor relay, Pump motor in hydraulic modulator (term.28 and term.14)	Ignition on, Press button 2 continuously (top picture)	LED 1 lit, pump motor running. After button is released, LED continues to light due to running-on of motor (top picture).	<ul style="list-style-type: none">* Motor relay defective* Check ground connection and positive terminal of hydraulic modulator* Check leads from controller term.14 and term.28 to hydraulic modulator term.9 and term. 11.* Pump motor defective



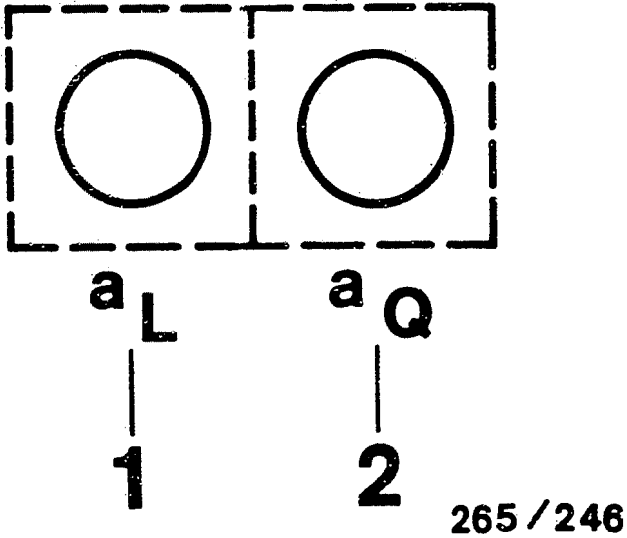
1 = Hydraulic modulator
2 = Motor relay
3 = Valve relay



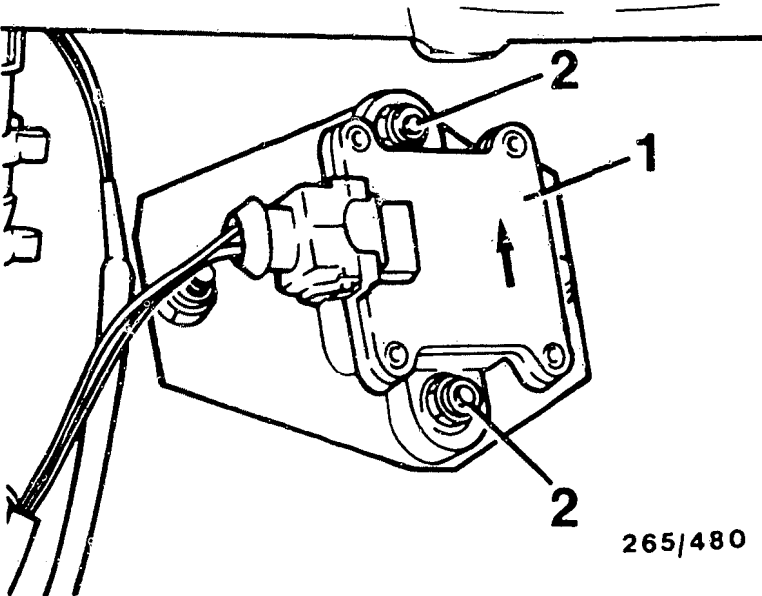
RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch setting 4

Testing of (measurement at terminals)	Add- itional operation	Test specification (indication)	Possible causes of fault
Acceleration sensor a _L (term. 16)	Ignition on	LED a _L lights up	<ul style="list-style-type: none">* Test acceleration sensor: Resistance: 500...800 Ω Replace sensor: Use self-locking nuts again to attach sensor. Pay attention to installation position. Arrow on sensor must face in direction of travel.* Test lead from acceleration sensor to ABS controller term. 16.* Test lead from controller term. 1 to acceleration sensor.

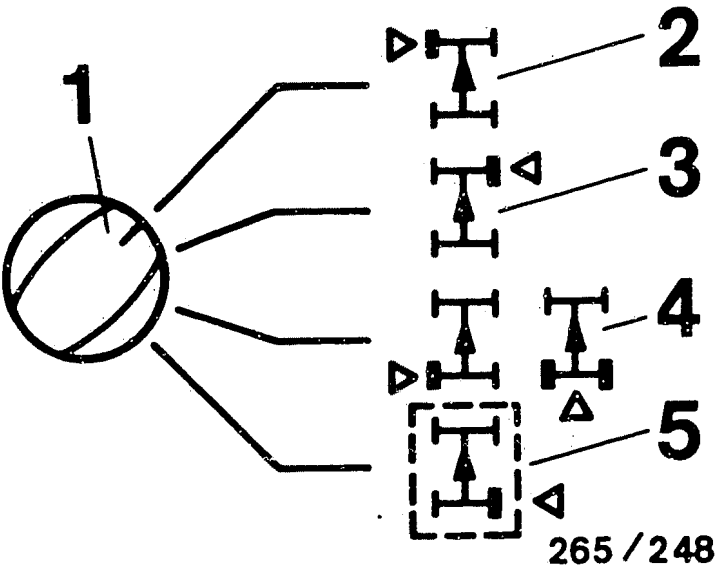
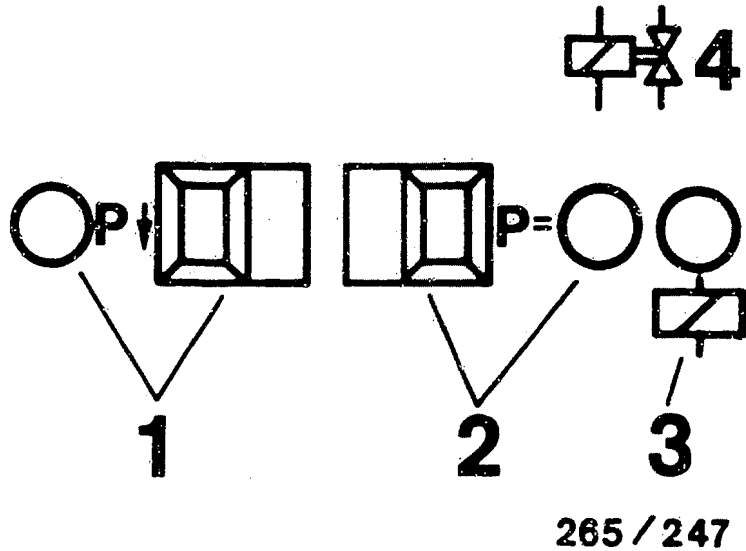


1 = Acceleration sensor
2 = Self-locking nut
Arrow = Direction of travel



RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch position 5 (3-channel hydraulic modulator)

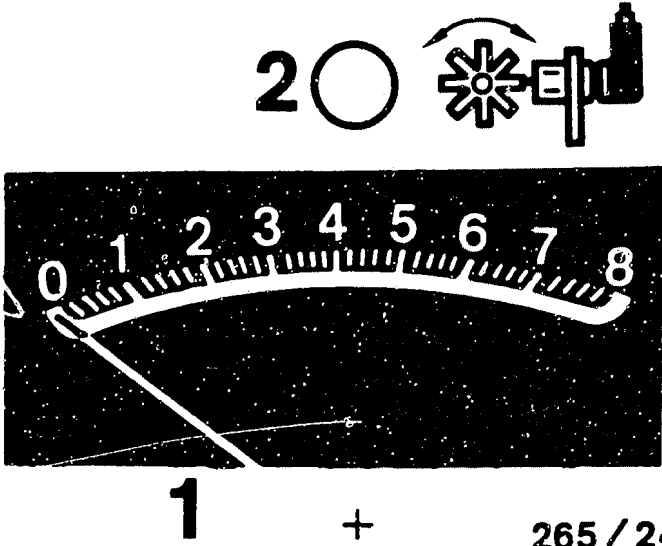
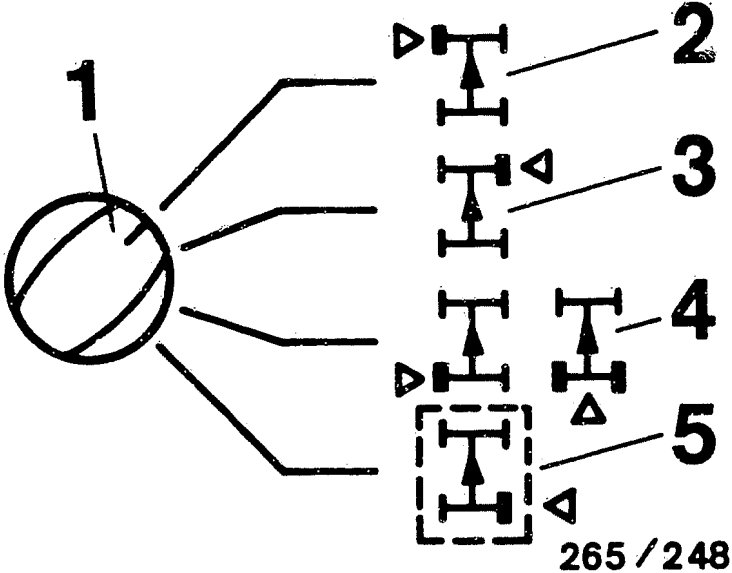
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Valve-relay opera- tion (term.27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Solenoid-operated valve in hydraulic modulator for operation and mix-up. NOTE: Check each wheel separately in turn. Keep to operating sequence!	Choke up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. Set switch 1 for wheel selection to wheel to be tested. For the rear axle, set to position 4 (lower illustration).		* Repeat test with engine running * Valve relay (make contact) defective * Break in line from valve relay term. 87 to batt. +ve * Brake leads at hydraulic modulator mixed up
Operation pressure holding	1. Constantly press push- button P= (lower illus.)	LED P= (lower illus.) lights up	* Current value not obtained (LED P arrow or P= goes out; upper illustration): battery insufficiently charged. Repeat check with engine running.
	2. Constantly depress brake pedal	Wheel turnable by hand	
	3. Release push- button P= (upper illustration)	LED P= goes out (upper illus.) Wheel locks	
Operation pressure reduction	4. Press push- button P arrow (upper illustration)	LED P arrow (upper illustration) lights up, wheel turnable by hand	* Solenoid-op. valves correct- ly connected electrically? Wheel, front left: term.2 Wheel, front right: term.35 Wheel, rear left: term.- Wheel, rear right: term.- Rear axle: term.18 * Hydraulic modulator defective
	5. Release push- button P arrow (upper illustration)	LED P arrow (upper illus- tration) goes out, wheel locks	
	6. Release brake pedal		



RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch setting 6 (4 wheel-speed sensor)

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Wheel-speed sensor for proper func- tioning and mix-up NOTE: Perform test consecutively for each individual wheel. Wheel, front left: term.4 + term.22 Wheel, front right: term.23 + term.21 on 80/90/100/200 quattro as of approx. 1.88 term.21 + term.25 Wheel, rear left: term.8 + term.9 Wheel, rear left: term.24 + term.26	Jack up vehicle. Ignition on. It must be possible to turn the wheel to be tested freely by hand. The wheel not being tested must be held when testing the driven axle. Set switch for wheel selection to wheel to be tested (bottom picture) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Speed approx. 1 rev- olution per second). Then read off value indicated on instrument: (top picture)	1. Smallest reading greater than 1,0 scale divisions 2. Smallest reading greater than 1,6 scale divisions 3. Permissible fluctuation band max. 11 % of maximum value displayed.	*Wheel-speed-sensor lead mixed up *Open-circuit in wheel- speed-sensor lead *Wheel-spd.-sens. defect. Winding resistance front and rear axle: 0,6...1,6 k Ω *Excessive air gap between wheel-speed sensor and ring gear *Ring gear defective or loose *Ring gear installed has incorrect no. of teeth Front axle: 96 teeth Rear axle: 96 teeth On Audi 80/90/100/200 quattro as of approx. 1. 88 Front axle: 45 teeth Rear axle: 45 teeth *Excessive wheel bearing play *Reading given, LED 2 does not light up: Loose contact in wheel- speed-sensor lead.



Continue testing on next coordinate.

TESTING DIFFERENTIAL LOCK

Note:

Pressing the pushbutton (DIFF) in the center console switches the differential lock on and off. The contact 3 of the ABS Combi relay is no longer used with the Audi 80/90 quattro as of 9.86.

- * Connect voltmeter between contact 3 and 2 as well as between 4 and 2.
Switch on ignition.
Set value: approx. battery voltage.

If set values are not obtained, test leads from plug of differential lock to ABS Combi relay.

- * Connect voltmeter between contact 5 and 2.
Set value approx. 0 V.
Press switch for differential lock (DIFF) and keep it pressed.
Set value: approx. battery voltage.

If set values are not attained, check routing of lead between control unit and switch in accordance with circuit diagram and replace switch if necessary.

- * Connect voltmeter between contacts 1 and 2.
Switch on ignition.
Set value 8...10 V.

If set value is not attained, check routing of lead.

Testing is to be performed as follows on the Audi 80/90 quattro, model year 87:

Engage rear differential lock at a speed of less than 25 km/h, ABS warning lamp must light up.
Increase speed to in excess of 25 km/h, ABS warning lamp must go out.

If functions are not found, replace control unit of differential lock and repeat test.

TEST SPECIFICATIONS

Wheel-speed sensor

- * Winding resistance at ambient temperature (-10°C...+120°C) for front axle: 600...1600 Ω
rear axle: 600...1600 Ω

Hydraulic-modulator solenoid valves

- * Winding resistance at ambient temperature (-10°C...+120°C): 0,7...1,7 Ω

- Air gap 0,8 \pm 0,5 mm

- * Automatic adjustment if use is made of new cap with Part No. 3 330 508 012.

Tightening torque for

- * fastening screws of wheel-speed sensors: > 8 Nm
- * brake-line connections at hydraulic modulator: 12...16 Nm

Number of teeth:

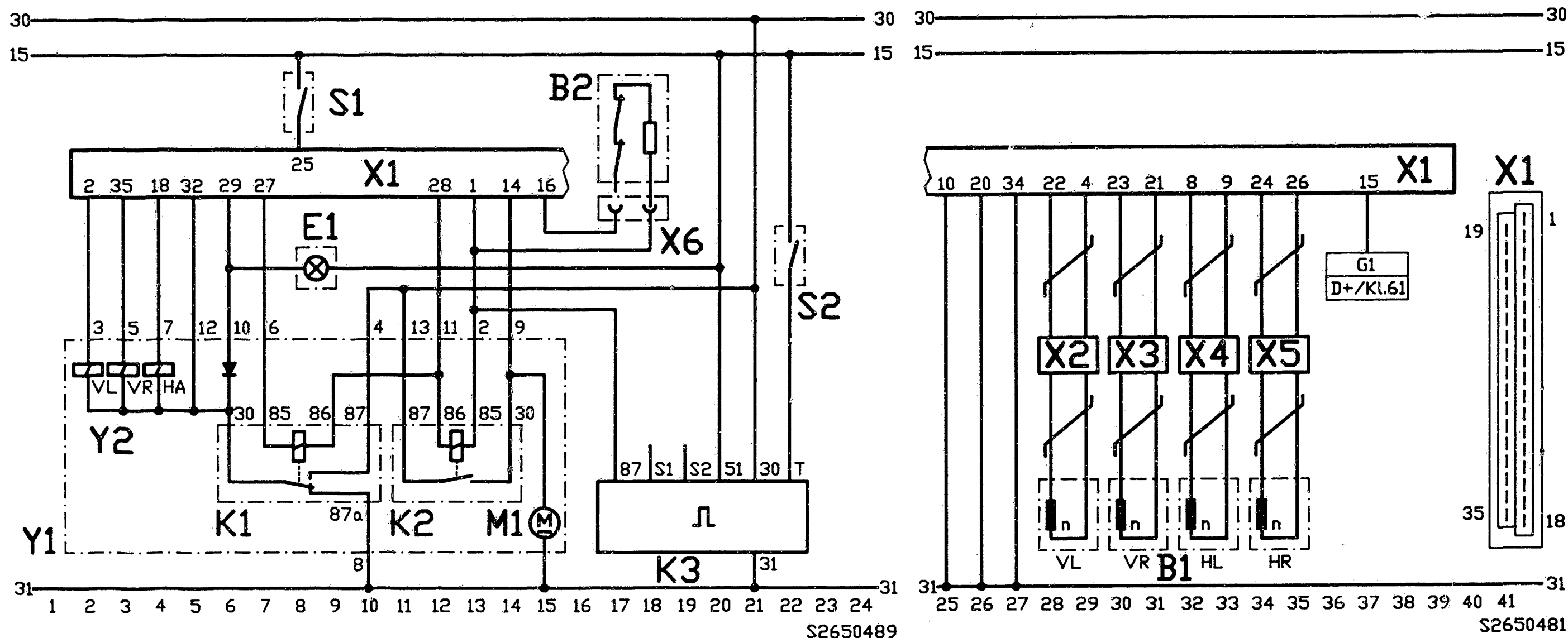
- * Front axle: 96 teeth
- * Rear axle: 96 teeth

Audi 80/90 as of 01.88

- * Front axle: 45 teeth
- * Rear axle: 45 teeth

Acceleration sensor

- * Contacts closed given horizontal position: 500...600 Ω

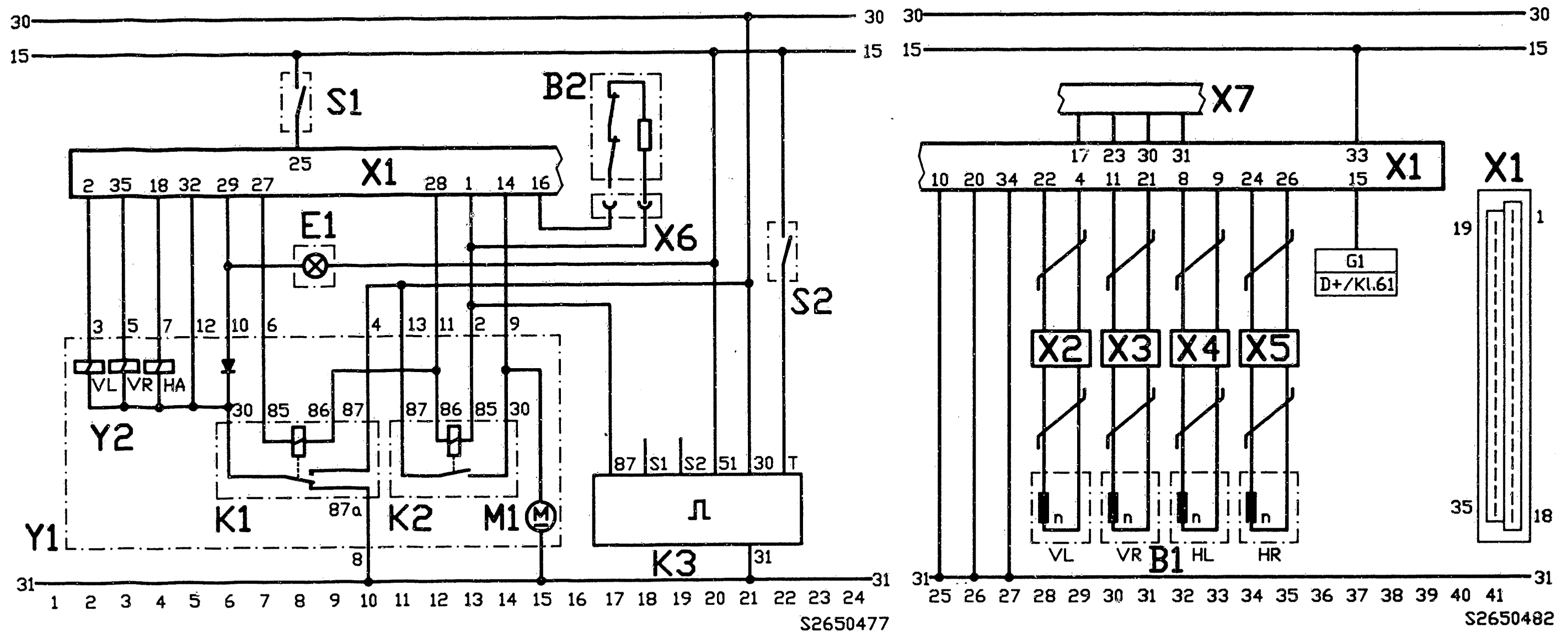


B1 = Wheel-speed sensor
 B2 = Acceleration sensor (a_L)
 H1 = ABS warning lamp
 G1 = to alternator
 K1 = Valve relay
 K2 = Motor relay
 K3 = Combi relay

M1 = Return-pump motor
 S1 = ABS button
 S2 = Stop-lamp switch
 X1 = Controller plug (35-pole)
 X2...X6 = Multiple butt connector
 Y1 = Hydraulic modulator
 Y2 = Solenoid valves

VL = Front left
 VR = Front right
 HA = Rear axle
 HL = Rear left
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM →1.88



B1 = Wheel-speed sensor
 B2 = Acceleration sensor (a_L)
 H1 = ABS warning lamp
 G1 = to alternator
 K1 = Valve relay
 K2 = Motor relay
 K3 = Combi relay

M1 = Return-pump motor
 S1 = ABS button
 S2 = Stop-lamp switch
 X1 = Controller plug (35-pole)
 X2...X6 = Multiple butt connector
 X7 = Plug, wheel-speed-sensor outputs
 Y1 = Hydraulic modulator

Y2 = Solenoid valves
 VL = Front left
 VR = Front right
 HA = Rear axle
 HL = Rear left
 HR = Rear right

ELECTRICAL TERMINAL DIAGRAM (with additional wheel-speed-sensor outputs) 1.88 —>

INSTALLATION POSITION OF COMPONENTS

The installation locations always refer to the direction of travel.

- * Controller (top picture):
Beneath seat bench, rear left.

AUDI 100/200 quattro: Beneath rear seat bench, on left, at heel board.

AUDI 80/90 quattro as of 1987: Beneath rear seat bench, left.

AUDI 80/90 quattro up to 1987: In trunk, right, next to fuel tank.

AUDI Coupe quattro up to 1988: In trunk, right, next to fuel tank.

AUDI quattro: In trunk, right, next to fuel tank

- * Stop-lamp switch:
At brake pedal.

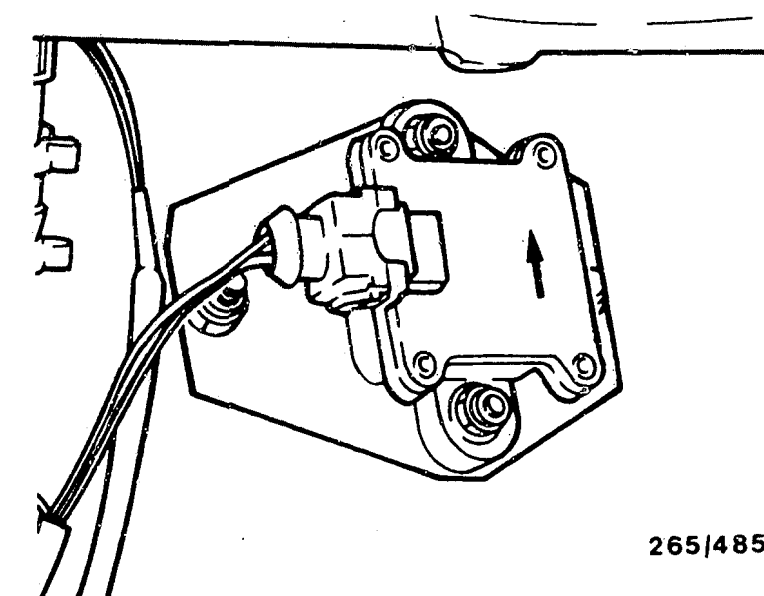
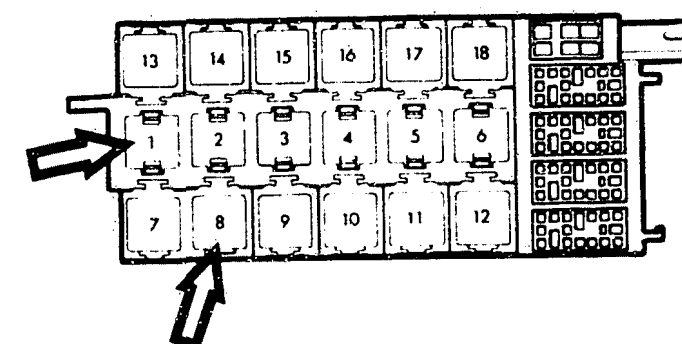
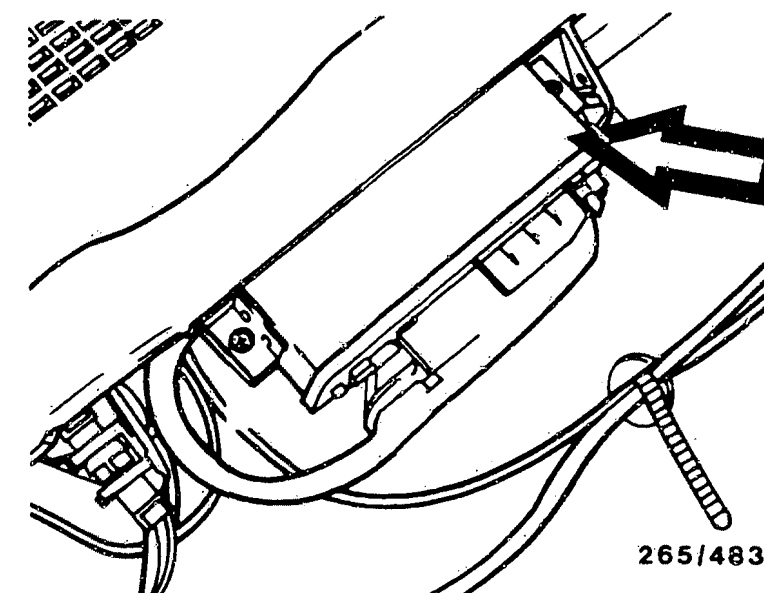
- * ABS warning lamp:
In instrument panel.

- * ABS switch:
In instrument panel

- * Combi relay (center picture):
Front left beneath instrument panel, relay position 1
in auxiliary relay holder on Audi 80/90 quattro or relay
position 8 on Audi 100/200 quattro, 5000 quattro.

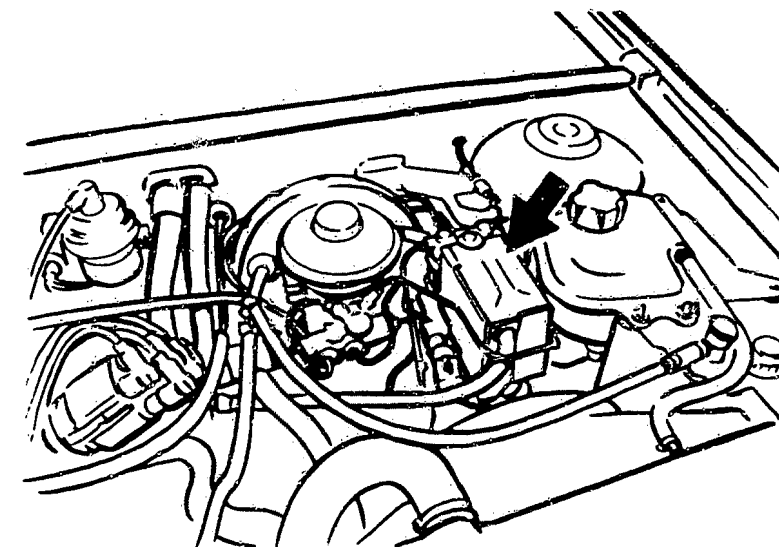
- * Ground terminal for ABS:
AUDI 80/90 quattro: Behind instrument panel, left
AUDI 100/200 quattro, 5000 quattro: Beneath rear seat bench, right.

- * Acceleration sensor (a_L) (bottom picture):
Beneath seat bench, rear left.
Arrow a on sensor faces in direction of travel.



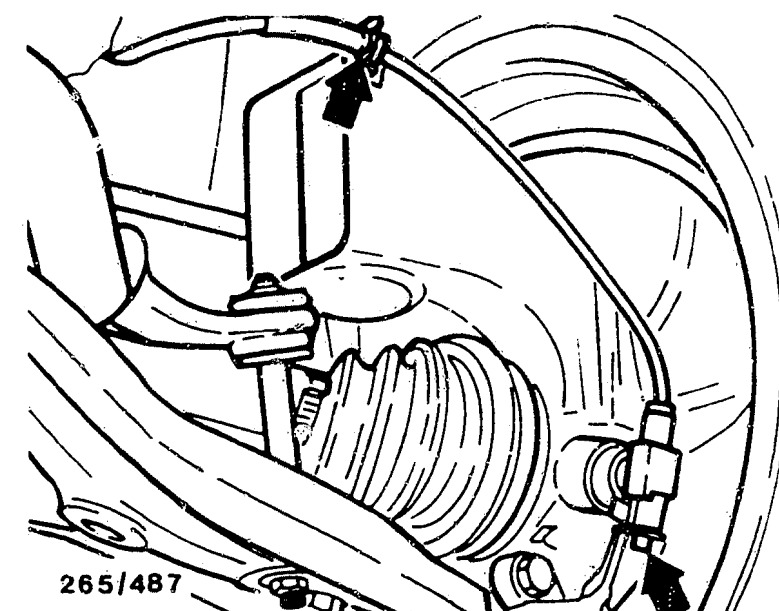
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- * Hydraulic modulator (top picture):
In engine compartment on left in direction of travel.



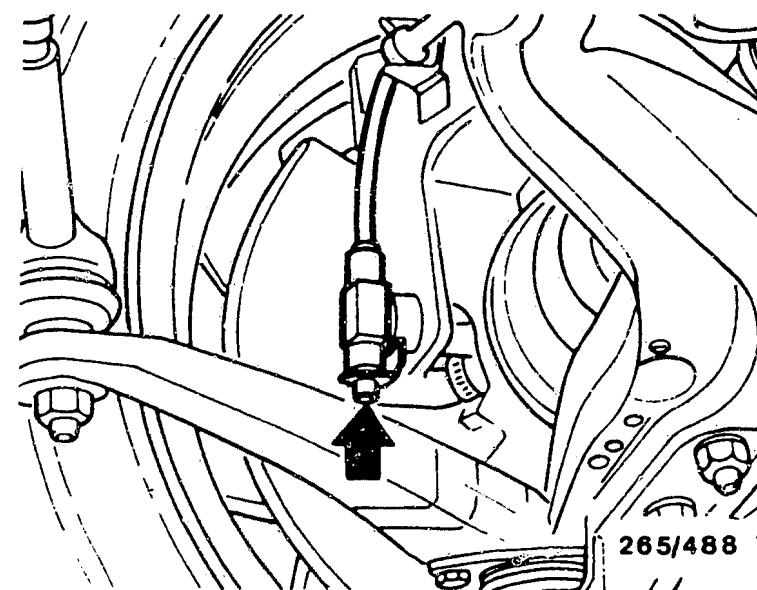
265/488

- * Front-axle wheel-speed sensor (center picture):
Attached on inside on right and left in wheel bearing housing.



265/487

- * Rear-axle wheel-speed sensor (bottom picture):
One each on left and right at wheel bearing housing.



265/488

TABLE OF CONTENTS

Trouble-shooting instructions : VWV-5010
BOSCH system : Ecotronic

Make of vehicle : VW
Basic microcard : MB-530

Section	Coordinate
Special features, safety, usage.....	02
Trouble-shooting chart.....	06
Self-diagnosis.....	08
Test specifications.....	19
Electrical terminal diagram.....	21
Installation position of components.....	23

SPECIAL FEATURES

- * This microcard, valid at the time of publication, contains trouble-shooting instructions for the following VW models:
Golf 10.87->
1,6l/4-cyl. engine code letter. PN
Passat, Jetta 10.87->
1,6l/4-cyl. engine code letter. PP
- * Ecotronic (ECO 4.0 B) with 25-pole control unit.
- * The control unit features self-diagnosis. Should a fault occur in the system, it is stored in the fault memory and can be read out with the aid of the diagnosis evaluation unit KDAW 9980. The control unit makes use of specified substitute values should a sensor fail.
- * The system is similar to the Ecotronic (ECO 3), Mercedes-Benz
See basic microcard.

SPECIAL FEATURES (continued):

The control range of the lambda closed-loop control system can be indicated by means of an evaluation unit KDAW 9980 or by means of a commercially available LED test lamp.

Testing and adjusting lambda closed-loop control range:

The correct setting of the lambda closed-loop control range is indicated by way of flashing pulses from the LED.

Initiation of indication:

- Switch off ignition for at least 20 s.
- Connect evaluation unit for flashing code KDAW 9980 socket 2 and socket 4 to test coupling for diagnosis (free lead in engine compartment). Connect evaluation unit socket 1 to +U_B and socket 3 to ground. Keep button on evaluation unit pressed and start engine.
- Release button on evaluation unit after engine has been running for at least 4 s.
- Bring lambda sensor up to operating temperature; to do so, increase engine speed for 1 min. to between in excess of 2000 and max. 3500 min⁻¹.
Note: If the engine speed is increased to in excess of 4000 min⁻¹, the indication is reset; initiate indication again.

Lambda closed-loop control within control range:
LED flashes 1,5 times per second.

Lambda closed-loop control on rich stop:
LED lights up all the time.

Lambda closed-loop control on lean stop:
LED does not light up.

Adjust closed-loop control range by way of idle-mixture-adjusting screw (top picture, arrow).

Note: LED flickers (25 times per second)

- Lambda sensor not at operating temperature
- Open-circuit in lead to lambda sensor.

Testing ACF bleeder valve for leaks:

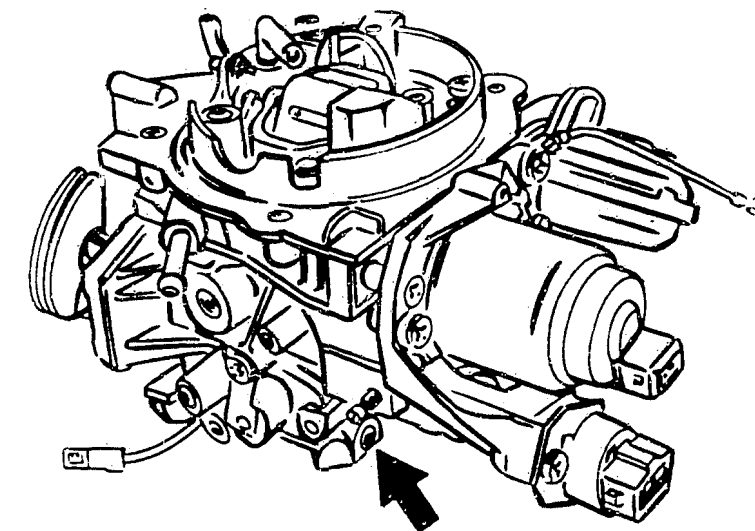
Remove ACF bleeder valve.

Connect vacuum pump (e.g. Mityvac) to intake-manifold connection of valve (center picture, 2).

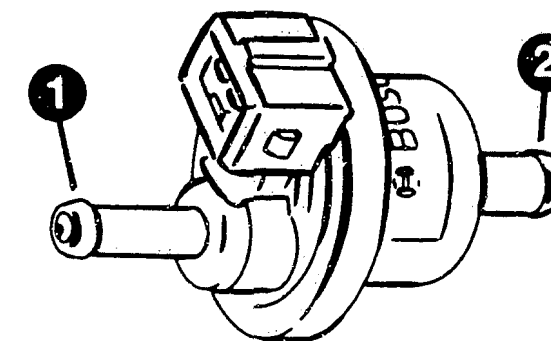
1. Valve deenergized → continuity (vacuum build-up not possible).
2. Actuate valve with battery voltage (10...15 V) (use connecting lead KDJE 7450/70) (bottom picture).

Generate vacuum of approx. 0,5 bar.

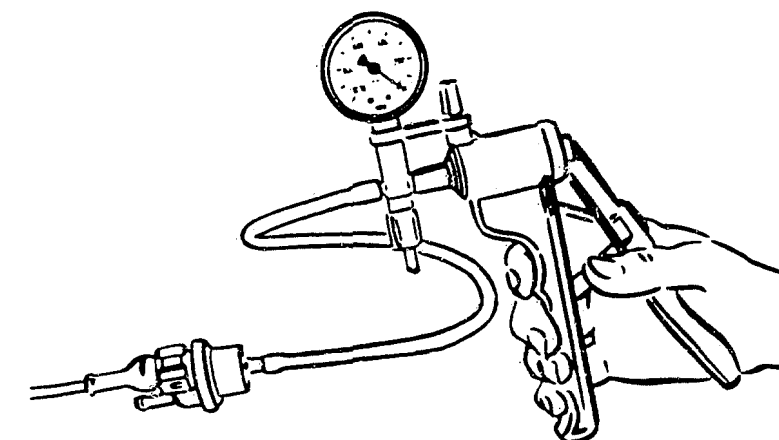
Permissible drop in pressure: 0,25 bar in approx. 10 s.



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TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

- Starting motor operates, engine fails to start or starts only with difficulty.
- Engine starts but then dies.
- Idle problems (engine speed, exhaust gas).
- Poor throttle take-up, flat spot during acceleration.
- Engine missing (ignition, induction of fuel).
- Maximum engine power/top speed not reached.
- Fuel consumption too high.
- Engine running on (dieseling).
- Engine pinging/knocking.
- Engine overheating.

Cause (component fault)									
	*					*			
Test setting of throttle valve, stage I									
	*	*	*	*	*				
Wrong type of nozzle									
		*		*					
Vacuum unit, stage II									
	*	*		*					
Test setting of throttle valve, stage II									
		*		*	*				
Test setting of throttle linkage									
	*	*							
Throttle valve worn									
	*	*		*					
Test TD signal									
				*	*				
Test enrichment pipe									
	*	*							
Test bypass heater									
*				*	*				
Defective float-chamber change-over valve									
	*	*							
Test ACF (visual inspection)									
	*								
Test vent. filter, throttle-valve actuator									

TROUBLE-SHOOTING:
HOW TO USE SELF-DIAGNOSIS:

This vehicle is fitted with a control unit which features self-diagnosis. Trouble-shooting must therefore always be commenced with self-diagnosis. The self-diagnosis is split up into two parts:

- Readout of fault memory (self-diagnosis)
- Actuator diagnosis

Following stimulation of the self-diagnosis by way of the diagnosis evaluation unit, all electronic control units installed in the vehicle, which feature self-diagnosis, are prompted to provide diagnosis output. The indicated Ecotronic faults are explained in the self-diagnosis test table starting on Coordinate 13. The self-diagnosis test table contains fault indication, component tested, test terminals at control-unit plug, cause of fault, test instructions and set values.

The trouble-shooting charts as of Coordinates 06 are only to be employed if there is no fault stored in the fault memory, but a customer complaint has nevertheless been received. The trouble-shooting charts only contain those components which are not tested by way of self-diagnosis.

HOW TO USE SELF-DIAGNOSIS AND SELF-DIAGNOSIS TEST TABLE

Connecting evaluation unit for flashing code KDAW 9980 (center picture):
Connect evaluation unit for flashing code KDAW 9980 socket 2 and socket 4 to test coupling for diagnosis (free lead in engine compartment, (top picture, arrow).
Connect evaluation unit socket 1 to +U_B and socket 3 to ground.

Activating self-diagnosis:

Allow engine to idle (if applicable, perform test drive beforehand) or crank starting motor for approx. 6 seconds (do not switch off ignition).

Press button on evaluation unit for more than 4 s.

Output of the self-diagnosis commences with a start signal (bottom picture, a) (fault lamp lights up for approx. 2,5 seconds).

Activating actuator diagnosis:

Switch off ignition (min. 20 seconds). Keep button on diagnosis evaluation unit pressed, switch on ignition.

Release button after more than 4 seconds.

In the course of actuator diagnosis output (flashing code 4432, 4323, 4324, 4342 and 4343)

the corresponding actuators are simultaneously activated during flashing-code output and can be tested by listening to them or feeling them (flashing code only indicates which component is actuated).

Note: Test TD signal if actuator diagnosis not possible.

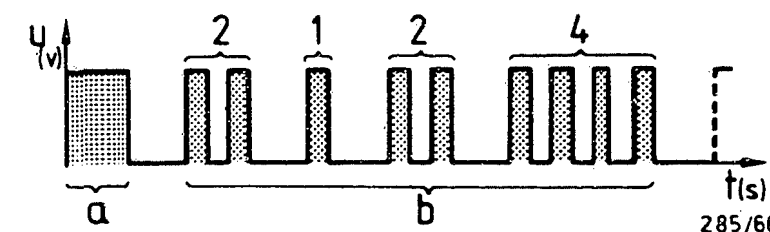
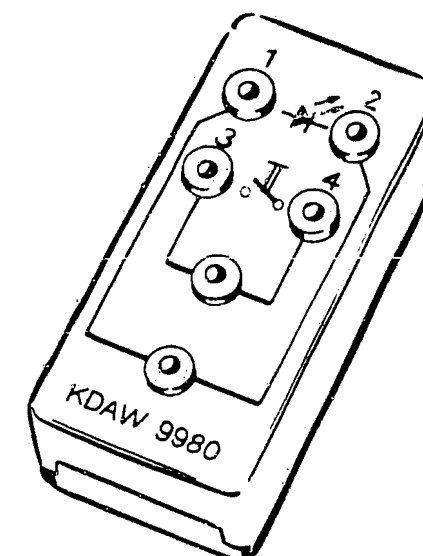
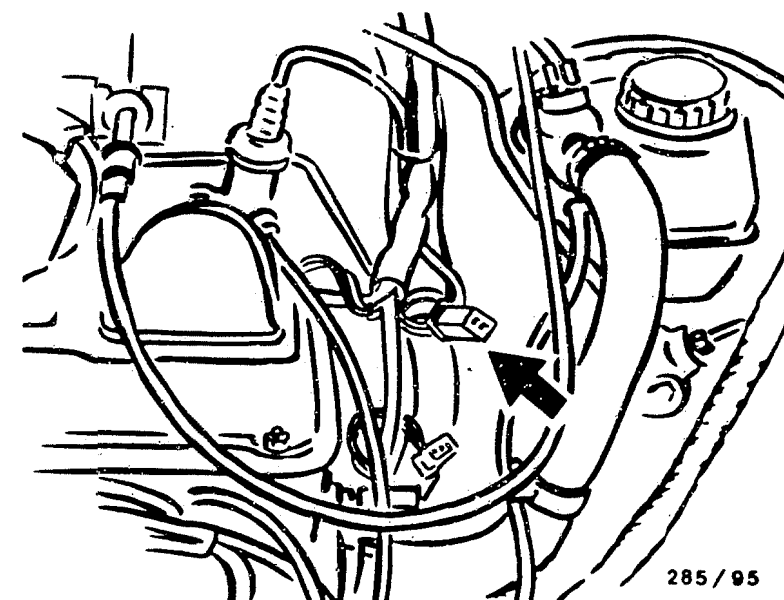
Continuing diagnosis:

Once a fault has been read out, the next fault is output or the next actuator is activated by pressing the button again (longer than 4 seconds).

N o t e :

The fault memory is cleared 15 seconds following switch-off of the ignition.

Should it not be possible to stimulate the control unit to output the diagnosis, the voltage supply of the control unit and the diagnosis lead from the control unit term. 6 to the diagnosis test coupling (free lead in engine compartment, top picture, arrow) are to be tested for open-circuits. If there is no engine-speed signal, the LED lights up brightly without the button on the evaluation unit being pressed and the fault memory cannot be read out.



HOW TO USE SELF-DIAGNOSIS AND SELF-DIAGNOSIS TEST TABLE

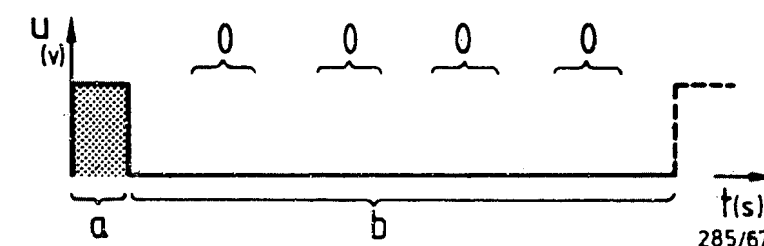
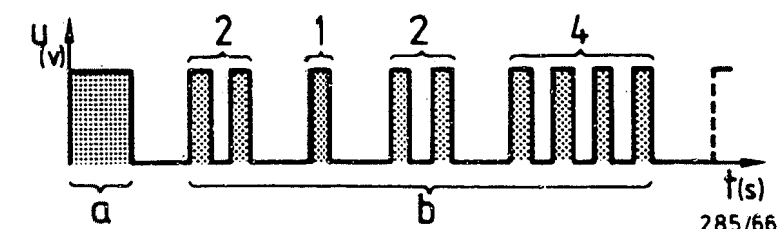
Evaluating flashing code (top picture, b):

The flashing code for each fault consists of four flashing-pulse blocks. Each block represents a number and contains between 1 and 4 pulses. One pulse corresponds to the number 1; four pulses correspond to the number 4. The fault lamp lights up briefly with each pulse.

The pause between the blocks is longer than that between the individual pulses. Between two fault codes continuation is effected by renewed pressing of the button for more than 4 seconds. The flashing code 4444 is output if there is no fault stored in the control unit.

If there is a fault stored in the control unit, the first fault (top picture, b) is output following the start signal. If a further fault is stored, its flashing code is called up by effecting continuation with renewed short-circuiting to ground.

Continuation must be effected until the flashing code 0000 (see bottom picture) indicates the end of the self-diagnosis process. The fault memory is cleared by switch-off of the ignition and deenergization of the main relay approx. 15 seconds later.



SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions / test conditions	Terminals	Set values
4444	Control unit	Control unit indicates that no fault is stored in the fault memory.	—	—
2214	Maximum speed exceeded	Maximum speed 7000 min^{-1} was exceeded when driving. (Test speed limitation on chassis dynamometer).	25 2 12 12	6950 min^{-1} $-0,6 \dots 2,8 \text{ A}$
2124	Potentiometer in throttle-valve actuator. Short-circuit to ground or open-circuit.	Parallel resistance of potentiometer, throttle valve and throttle-valve actuator: Wiper resistance of potentiometer in throttle-valve actuator: (Actuate evacuating valve in throttle valve actuator during test and pull throttle-valve actuator back with manual vacuum pump). Resistance decreases constantly.	18 13 17 13 17 13	$0,7 \dots 1,3 \text{ k } \Omega$ max: $1,4 \dots 2,4 \text{ k } \Omega$ min: less than 400Ω
2212	Throttle-valve potentiometer. Short-circuit to ground or open-circuit.	Parallel resistance of potentiometer, throttle-valve and throttle-valve actuator: Wiper resistance of throttle-valve potentiometer: Allow engine to idle. Seal vented side of throttle-valve actuator. Switch off engine. Switch on ignition. Slowly depress accelerator pedal as far as it will go starting from idle position: Resistance constantly changes between min. and max.	18 13 11 13 11 13	$0,7 \dots 1,3 \text{ k } \Omega$ max: $1,4 \dots 2,4 \text{ k } \Omega$ min: less than 270Ω

SELF-DIAGNOSIS TEST TABLE (continued)

Fault indication Flashing code	Testing of component/function	Test instructions / test conditions	Terminals	Set values
2312	Temperature sensor (coolant). Short-circuit to ground or open-circuit	Temperature-sensor resistance: at 20°C at 80°C	21 13 21 13	2,0...3,0 k Ω 280...360 Ω
2341	Lambda closed-loop control at closed-loop control limit	Test lambda closed-loop control and re-adjust closed-loop control range: Initiate indication of lambda closed-loop control range.	6	LED on evaluation unit flashes at 1,5 Hz
2342	Lambda sensor	Test lead from control unit term. 8 to plug connection of lambda sensor for short-circuit to ground or battery +: (Lambda-sensor plug connection detached) Test lead for open-circuit:	8 (-) 8 (+) 8	greater than 1M Ω greater than 1M Ω approx. 0 Ω
2412	Temperature sensor (intake air). Short-circuit to ground or open-circuit.	Temperature-sensor resistance: at 20°C at 80°C	5 13 5 13	2,0...3,0 k Ω 280...360 Ω
4432	Choke-valve actuator. Short-circuit to ground.	Test resistance of choke-valve actuator: Test insulation resistance of choke-valve actuator:	10 12 10 20	less than 10 Ω greater than 1 M Ω
2122	No TD signal	Test TD signal during starting process: Fault is only indicated if TD signal was present when engine was last started. (Only indicated as of control unit 0 285 007 042 ..043)	25 20	Rectangular pulses between 0 and 12 V
0000	End of diagnosis output	Control unit indicates that diagnosis output has been completed. Fault lamp flashes at 2,5 second intervals (start signal).	—	—

SELF-DIAGNOSIS TEST TABLE (continued)

Final-controlling-element diagnosis (component is activated by control unit during flashing-code output).

Flash code	Testing of components/function	Test instructions/Test conditions	Terminals	Set values
4432	Choke-valve actuator	Choke-valve actuator is activated during diagnosis output. Insulation resistance of choke-valve actuator: Winding resistance of choke-valve actuator:	10 12 10 12	greater than 1M Ω less than 10 Ω
4343	Activated-carbon-filter bleeder valve	Final-controlling-element diagnosis: bleeder valve is actuated during flashing-code output. Insulation resistance Winding resistance	15 2 15 23	greater than 1 M Ω less than 100 Ω
4342	Relay for intake pre-heating	Final-controlling-element diagnosis: relay is actuated during flashing-code output. Insulation resistance Winding resistance	14 2 14 23	greater than 1 M Ω less than 100 Ω
4323	Ventilating valve in throttle-valve actuator	Final-controlling-element diagnosis: ventilating valve is actuated during flashing-code output. Insulation resistance, ventilating valve: Winding resistance, ventilating valve:	9 2 9 23	greater than 1M Ω 20...80 Ω
4324	Evacuating valve in throttle-valve actuator	Final-controlling-element diagnosis: evacuating valve is actuated during flashing-code output. Insulation resistance, evacuating valve: Winding resistance, evacuating valve:	3 2 3 23	greater than 1M Ω 20...80 Ω
0000	Diagnosis output complete	Control unit indicates that the diagnosis output is complete. Fault lamp flashes at 2,5 s. interval (start signal).	—	—

TEST SPECIFICATIONS:

Idle speed: 900±75 min⁻¹

Note: the idle speed is controlled and cannot be adjusted.

Engine-speed limitation 7000 min⁻¹

Exhaust-gas adjustment:

Test CO value at sampling pipe before catalytic converter: %CO by vol. 0,2...1,0
To do this, hose for engine ventilation and lead to lambda sensor are disconnected.

Fuel pressure: 0,1...0,3 bar

Minimum fuel delivery (at 2000 min⁻¹) 1 l/min

Float weight: (dry) 7,9±0,5 g

Float height: 27,5±1,0 mm

(Float level cannot be adjusted)

Throttle-valve potentiometer

Total resistance: 1,4...2,6 k Ω

Wiper resistance in correcting range: min. less than 270 Ω
max. 1,4...2,4 k Ω

Choke-valve actuator

Winding resistance: 0,9...1,7 Ω

Basic setting, throttle valve

Stage I (with feeler gauge) 3,15 mm

Stage II a = 0,03±0,02 mm

Release and forced return

Stage II: Y = 1,0±0,3 mm

Z = 0,4±0,2 mm

Float-chamber change-over valve

Winding resistance less than 50 Ω

Activated-carbon-filter bleeder valve

Winding resistance: 20...90 Ω

TEST SPECIFICATIONS (continued):

Choke-valve actuator

Evacuating valve (term. 1/2): 20...70 Ω

Venting valve (term. 6/7): 20...70 Ω

Total potentiometer

resistance (term. 3/4): 1,4...2,6 k Ω

Wiper resistance in correcting

range (term. 5/3): min. < 400 Ω
max. 1,4...2,4 k Ω

Temperature sensor (intake air)

Internal resistance at 20°C: 2,0...3,0 k Ω

at 80°C: 280...360 Ω

Heating element, intake-manifold heater:

Internal resistance at 20°C: approx. 0,25...0,5 Ω

Heating element, part-load channel:

Internal resistance at 20°C: approx. 1,5...2,5 Ω

Nozzles:

	Stage 1	Stage 2
Main nozzle	x 105	x 110
Idle fuel nozzle	x 45	
Acceleration fuel nozzle		90
Air correction nozzle (with mixing pipe)	x 110	x 105
Acceleration air nozzle		x 130

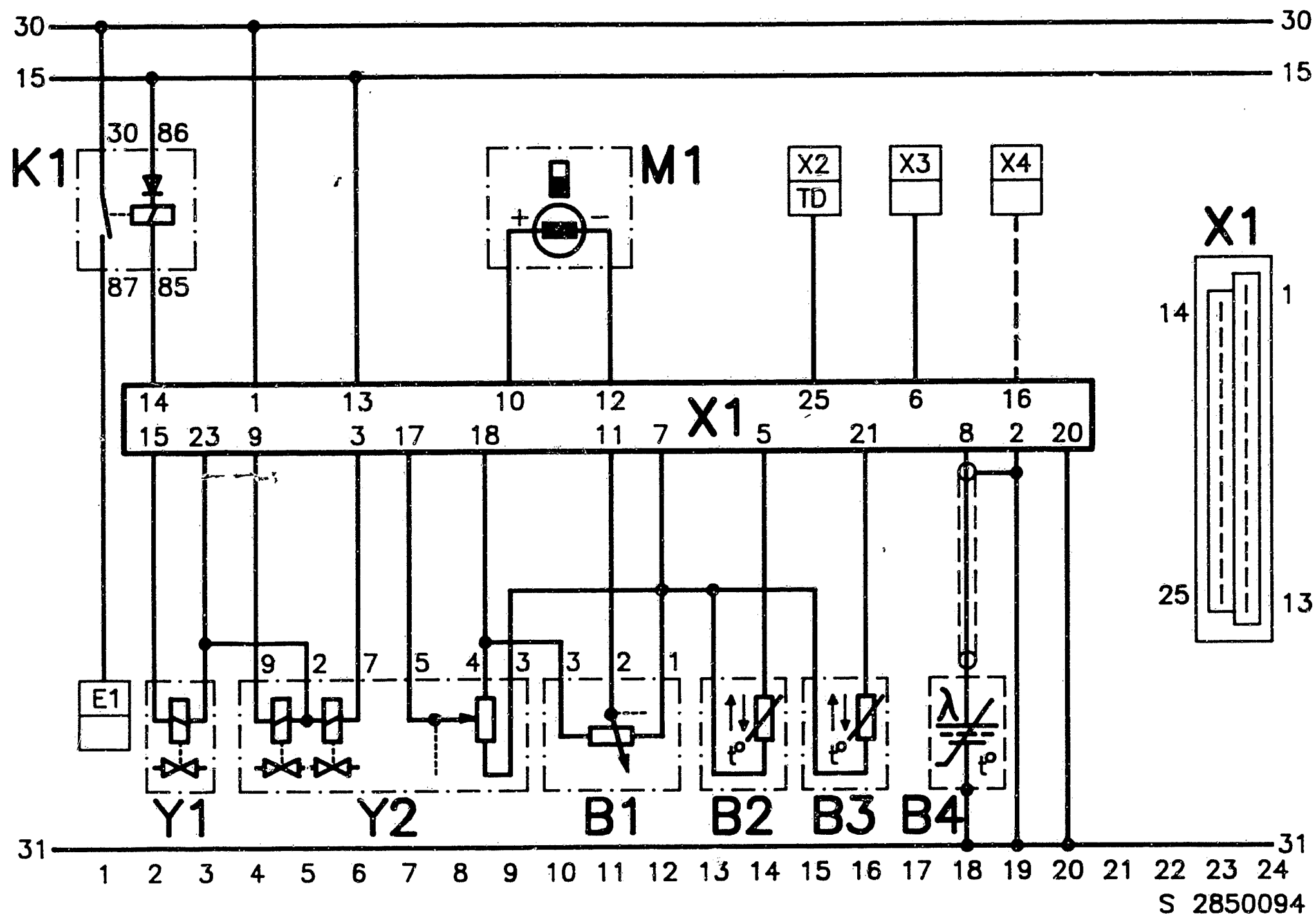
Pipe for full-load enrichment

Height above pre-atomizer 13,5±1,0 mm

Tightening torques

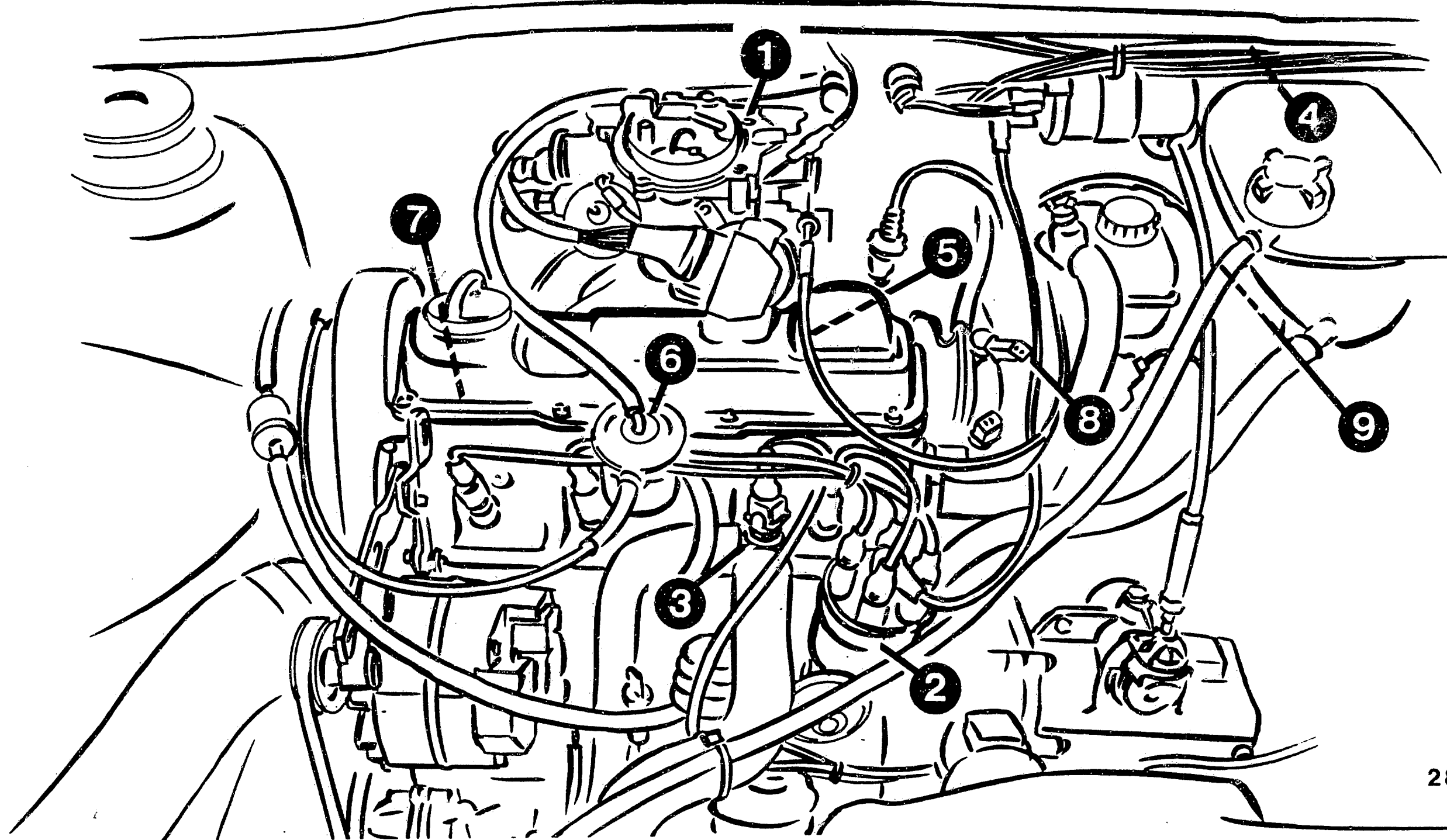
Carburetor mount 7 Nm

Please refer to equipment and Autodata microcard for settings as regards valve clearance and other engine-related data.



B1 = Potentiometer	E1 = Intake-manifold heater	X2 = Plug, ignition trigger box
Main throttle valve	K1 = Relay, intake-manifold heater	X3 = Diagnosis test coupling
B2 = Temp. sensor, intake manifold	M1 = Choke-valve actuator	X4 = Plug, transmission identifier
B3 = Temperature sensor, coolant	X1 = Ecotronic control-unit plug	Y1 = ACF valve
B4 = Lambda sensor		Y2 = Throttle-valve actuator

ELECTRICAL TERMINAL DIAGRAM OF ECOTRONIC



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1 = Carburetor
2 = Ignition distributor
3 = Temperature sensor
Coolant

4 = Ecotronic control unit
(under cover)
5 = Temp. sens., intake manifold
6 = Vapor bubble eliminator

7 = Sampling pipe for CO measurement
8 = Free lead for adjusting closed-loop
control range of lambda sensor
Lambda sensor is installed in
flame tube
9 = ACF

INSTALLATION POSITION OF COMPONENTS

Trouble-shooting instructions : POR-5009

BOSCH system : LH 2.3-Jetronic

Make of vehicle : PORSCHE

Basic microcard : PKW-114

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models:

PORSCHE 928 S 4 08.86->
PORSCHE 928 Club Sport 09.87->
with 4.957 l / 8-cyl. engine M28/41 and M28/42
32 valves, worldwide version

* LH2.3-Jetronic with 35-pole control unit:
0 280 002 504/ ... 506.

* As of model year 1988 self-diagnosis
with flashing-code output.

* Lambda closed-loop control with adaptive
basic adjustment.

* Adaptive idle-speed regulation with
single-winding rotary actuator.

* Pulsed tank ventilation valve.

* Engine-speed triggering by TN signals
from term. 13 of ignition control unit.

* Twin temperature sensor (engine) for
Jetronic and ignition.

* Vehicles without lambda closed-loop control
feature a separate idle CO potentiometer
at the control-unit retaining plate.

* 8-pole control-unit encoding connection.
The country variants are realized by way
of various encoding plugs.

* 12-pole diagnosis plug at control-unit retaining
plate for Jetronic and ignition.

* Switchable intake-manifold resonance flap.
Switching conditions, engine speed in excess
of 3500 min⁻¹ and at least 1/3 engine load.

SPECIAL FEATURES (CONTINUED)

* Use is to be made for fuel-pressure testing of a pressure measuring device without directional-control valve.
Carefully unscrew cap of test connection (at front on right-hand fuel distribution pipe), sealing cone drops out. Connect pressure gauge only with hose and union nut M12x1.5.

Adaptive idle-speed regulation:

Temperature-dependent prescribed engine speeds are stored in the control unit. Engine-speed drifts are detected by the control unit and offset by altering the pilot control. The engine-speed control span is expanded by the adaption range.

Lambda closed-loop control with adaptive basic adjustment:

Applied pilot-control values are stored in the control unit.
Changes in operating conditions, caused for example by intake air, fuel, engine management or fuel induction, are detected and compensated for by the learning capability of the control unit. The Lambda control span is expanded by the adaption range.

Tank ventilation with controlled tank ventilation valve:

A pulsed tank ventilation valve doses the fuel vapors drawn in by the engine from the active-carbon container.
For this purpose, the control unit applies a variable on/off ratio as a function of load to the tank ventilation valve which is open when deenergized.

SPECIAL FEATURES (CONTINUED)

Self-diagnosis with flashing-code output:

As of model year 1988, the Jetronic and ignition control units are equipped with self-diagnosis and marked with the sticker "DIA".

Caution: Do not detach control-unit plug, and do not even disconnect battery, since this would clear the fault memory.

Scope of diagnosis:

- * Readout of fault memory, self-diagnosis
- * Actuator diagnosis
- * Switching-element diagnosis

Test prerequisite:

Voltage supply, positive and negative, of control unit O.K.

Battery positive: at term. 4 and via main relay term. 87 at term. 9

Positive from term. 15: at term. 33

Ground: at term. 5 and term. 17

Diagnosis plug (at control-unit retaining plate)

Battery positive: at term. 5

Positive from term. 15: at term. 1

Ground: at term. 2

Lead connections,

term. 11 to control unit term. 22

term. 10 to control unit term. 12

term. 12 to control unit term. 16

Flashing code:

Connect evaluation unit KDAW 9980 to diagnosis plug.

Socket: to terminal:

1 (+LED) 1

2 (-LED) 11

3 (pushbutton) 12

4 (pushbutton) 2

SPECIAL FEATURES (CONTINUED)

Conditions:

If the fault memory has been cleared,

- * Test drive for at least 5 minutes
- * Engine speed min. 1x in excess of 3000 min⁻¹
- * Fully depress accelerator pedal min. 1x
- * Coolant temperature 80°C.
- * If the engine doesn't run, start for at least 6 seconds and leave ignition "ON".

Interrogate self-diagnosis at idle speed or with ignition "ON".

Activation of self-diagnosis:

Press pushbutton of evaluation unit for 2.5 ... 5 s.

1, 2 or 4-digit fault code is indicated by

LED flashing. Note down code.

Read out all fault codes by repeatedly pressing pushbutton until "1" (end of fault output) appears.

Evaluate flashing code - refer to self-diagnosis test table.

Note:

Renewed pressing of the pushbutton triggers the self-diagnosis of the EI-K control unit. (Refer to SIS EI-K ignition for fault elimination).

CLEARING FAULT MEMORY:

Press pushbutton for at least 10 s whilst fault code "1" is being displayed.

Activating actuator and switching-element diagnosis:

Keep pushbutton depressed, ignition "ON"

and press pushbutton for a further 2.5 ... 5s.

LED flashes in actuator diagnosis.

Repeated pressing of button consecutively activates actuators and switching elements.

1st position: 1 = LH control unit
2 = EI-K control unit

2nd position: 1 = Sustained fault
2 = Sporadic fault
3 = Actuator activation
4 = Demand adaption
5 = No fault stored

3rd+4th pos. = Fault code

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.

For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!

High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

- * Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptom)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems
(Engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing
(ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

									Cause (component fault)
*	*	*	*	*	*	*	*	*	* Self-diagnosis
*	*	*	*	*	*	*	*	*	* Actuator/switching-element diag.
*	*	*	*						Idle actuator
	*	*	*	*	*	*			Air-mass meter
*	*	*	*		*				Intake system
*		*	*	*		*	*		Solenoid-operated injection valves
*	*	*	*		*	*			Fuel pressure/fuel pump
				*	*				Fuel delivery
		*	*		*	*			Throttle valve
			*						Overrun cutoff
*		*							Start control
			*						Ground connection
*		*	*	*					Alternator, interference supp.
		*	*	*		*			CO exhaust-gas setting
*				*					Control unit
					*				Catalytic converter
	*	*	*	*	*	*		*	Lambda closed-loop control
*	*	*	*			*			Tank ventilation system

For production reasons:
continued on the following
coordinate.

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
1	Control unit	End of self-diagnosis output		
1 5	Control unit	No fault stored		
1 1 1 1 1 2 1 1	Control unit, leads/ supply voltage	Supply voltage for control unit too low or too high. Test battery and alternator. Test for contact resistance in leads. Test main relay and control unit term. 21.	9 - 5 (+) (-)	12...14 V with engine idling
1 1 1 2 1 2 1 2	Throttle-valve switch, leads/ setting, idle contact	Throttle-valve switch incorrectly set. Detach EI-K control-unit plug. Measure resistance directly at idle switch. Throttle valve closed: Throttle valve open: Test for contact resistance in leads. Re-attach EI-K control-unit plug.	2 - 5 2 - 2	0 Ω infinity Ω
1 1 1 3 1 2 1 3	Throttle-valve switch, leads/full-load contact	Detach EI-K control-unit plug. Measure resistance directly at full-load switch. Throttle valve closed: Completely open throttle valve: Test for contact resistance in leads. Re-attach EI-K control-unit plug.	3 - 5 3 - 3	infinity Ω 0 Ω
1 1 1 4 1 2 1 4	Temperature sensor (engine) Leads/ resistance	Measure resistance directly at temperature sensor. +15...+30°C: approx. +80°C: Test for contact resistance in leads.	13 - 5 13	1.45...3.3 k Ω 280...360 Ω

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
1 1 2 1 1 2 2 1	Air-flow sensor, leads/ voltage, resistance	Switch on ignition, Measure voltage directly at connector: Start engine, Measure voltage directly at connector: Voltage is a function of load. Detach connector. Measure resistance directly at air-mass meter: Test leads for contact resistance. Attach connector.	2 - 4 (+) (-) 5 - 3 (+) (-) 5 - 3	8...15 V 2... 5 V 3.6...4.1 Ω
1 1 2 2 1 2 2 2	Idle rotary actuator, leads/ voltage, resistance	Switch on ignition, Measure voltage directly at connector: Start engine, Measure resistance directly at idle actuator: Test signal at control unit.	33 - 9 (-) (+)	8...15 V 4...12 Ω
1 1 2 3 1 2 2 3	Lambda sensor, leads/ sensor detects too lean a mixture; closed- loop control effects enrichment	Test sensor lead for short-circuit to grd. (shield). Test sensor heater, Resistance: Supply voltage: Sensor ceramics clogged. Fuel pressure too low, Leak in intake system (leakage air).	24 - 5	1...15 Ω 8...15 V 3.6...4.0 bar
1 1 2 4 1 2 2 4	Lambda sensor, leads/ sensor detects too rich a mixture; closed-loop control effects leaning	Test sensor lead for interference and sensor for connection to heater positive. Test ground connection. Test sensor heater, Resistance: Supply voltage: Fuel pressure too high, Tank ventilation valve permanently open.	24 - 5	1...15 Ω 8...15 V 3.6...4.0 bar
1 1 2 5 1 2 2 5	Lambda sensor, leads/ function, open-circuit.	Test sensor lead for open-circuit, short-circuit to ground or to heater positive. Test sensor heater, Resistance: Supply voltage: Sensor ceramics defective.	24 - 5	1...15 Ω 8...15 V

ACTUATOR/SWITCHING-ELEMENT DIAGNOSIS TEST TABLE

Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
1 3 1 1	Injection valves, leads/actuation of valves	Detach plugs from all injection valves. Connect one injection valve in each case. This valve must be heard to function. Test all injection valves one after the other. Measure resistance directly at inj. vlv.: +15...+30°C: Test leads from control unit and main relay to valves for short-circuit/open-circuit.	18 - 9 (-) (+)	14.5...17.5 Ω
1 3 2 1	Idle rotary actuator, leads/actuation of idle actuator	Idle actuator must be heard or felt to operate. Measure resistance directly at idle actuator: Test leads from control unit and main relay to idle actuator for short-circuit/open-circuit.	33 - 9 (-) (+)	4...12 Ω
1 3 2 2	Tank ventilation valve, leads/actuation	Tank ventilation valve must be heard or felt to function. Measure resistance directly at valve: Test leads from control unit and main relay to ventilation valve for short-circuit/open-circuit.	27 - 9 (-) (+)	35...55 Ω
1 3 2 3	Resonance flap, leads/actuation	Resonance flap must be heard or felt to function. Test leads from control unit and main relay to valve for flap for short-circuit/open-circuit.	34 - 9 (-) (+)	
1 3 3 1	EI-K control unit, leads/engine-speed signal at LH control unit	Actuate starting motor for approx. 5 s. Test leads from term. 1 to EI-K control unit term. 13 and ground lead term. 17 for open-circuit.	1 - 17 (+) (-)	

ACTUATOR/SWITCHING-ELEMENT DIAGNOSIS TEST TABLE

Flashing code	Testing of component/function	Test instructions/Test conditions	Terminals	Set values
1 3 3 2	Throttle-valve switch, leads/adjustment, idle contact	<p>Slightly open throttle valve during flashing phase. Flashing code goes out if signal is O.K.</p> <p>Throttle-valve switch incorrectly set. Detach EI-K control-unit plug. Measure resistance directly at idle switch, Throttle valve closed: Throttle valve open:</p> <p>Test leads for contact resistance. Re-attach EI-K control-unit plug.</p>	<p>2 - 5</p> <p>2 - 2</p>	<p>0 Ω infinity Ω</p>
1 3 3 3	Throttle-valve switch, leads/full-load contact	<p>Completely open throttle valve during flashing phase. Flashing code goes out if signal is O.K.</p> <p>Detach EI-K control-unit plug. Measure resistance directly at full-load switch, Throttle valve closed: Completely open throttle valve:</p> <p>Test leads for contact resistance. Re-attach EI-K control-unit plug.</p>	<p>3 - 5</p> <p>3 - 3</p>	<p>infinity Ω 0 Ω</p>
1 3 3 4	Switch, leads/A/C readiness	<p>Switch on A/C during flashing phase. Flashing code goes out if signal is O.K.</p> <p>Test A/C switch Test leads from ignition and starting switch and ctrl. unit to A/C switch for short-circ./open-circ.</p>	15 - 5	
1 3 3 5	Switch, leads/A/C compressor	<p>Switch on A/C during flashing phase. Flashing code goes out if signal is O.K.</p> <p>Test A/C switch. Test leads from ignition and starting switch and ctrl. unit to A/C switch for short-circ./open-circ.</p>	14 - 5	
1 3 3 6	Drive switch Automatic transmission	<p>Only for vehicles with automatic transmission. During flashing phase, shift selector lever from P or N into a driving position. Flashing code goes out if signal is O.K.</p>	30 - 17	

TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pump	
* Return delivery:	min. 1250 cm ³ /30 s
* Supply voltage under load:	min. 12 V
* Delivery of pre-supply pump:	min. 1350 cm ³ /30 s
Pressure regulator	
* Fuel pressure with engine stopped when idling:	3,6...4,0 bar approx. 0.5 bar less
Fuel system, leakage	
* Fuel pressure after engine stopped for 20 min.:	min. 1.0 bar
Idle actuator	
* Resistance at +15...+30°C :	4...12 Ω
Hot-wire air-mass meter	
* Resistance between term. 6 and term. 3:	0...1100 Ω
term. 5 and term. 3:	3.6...4.1 Ω
Temperature sensor (engine) Twin version	
* Internal resistance at ambient temperature +15...+30°C:	1.45...3.3 k Ω
with engine at operating temperature approx. + 80°C:	280...360 Ω

TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
Solenoid-operated injection valve	
* Internal resistance at ambient temperature +15...+30°C:	14.5...17.5 Ω
* Leak rate after 60 s:	no droplet may drip off
Start control	
* Voltage at injection valve on start initiation: after approx. 15 s:	greater than 1.5 V approx. 0.5 V
Idle-speed adjustment	
Engine at operating temperature approx. +80°C	
* Idle speed:	650...700 min ⁻¹
Adjustment not necessary, since engine speed regulated adaptively.	
CO adjustment	
Engine at operating temperature, approx.+80°C	
* Veh. with no lambda clsd.-loop-ctrl.:	0,5...1,5 vol.% CO
Adjustment at CO potentiometer beneath control unit.	
* Veh. with Lambda closed-loop ctrl.:	0,4...1,2 vol.% CO
(CO sampling ahead of catalytic converter)	
Adjustment not required, in view of adaptive closed-loop control.	
Lambda-sensor heater	
* Internal resistance (PTC) with engine not running:	1...15 Ω
Tank ventilation valve	
* Internal resistance:	35...55 Ω

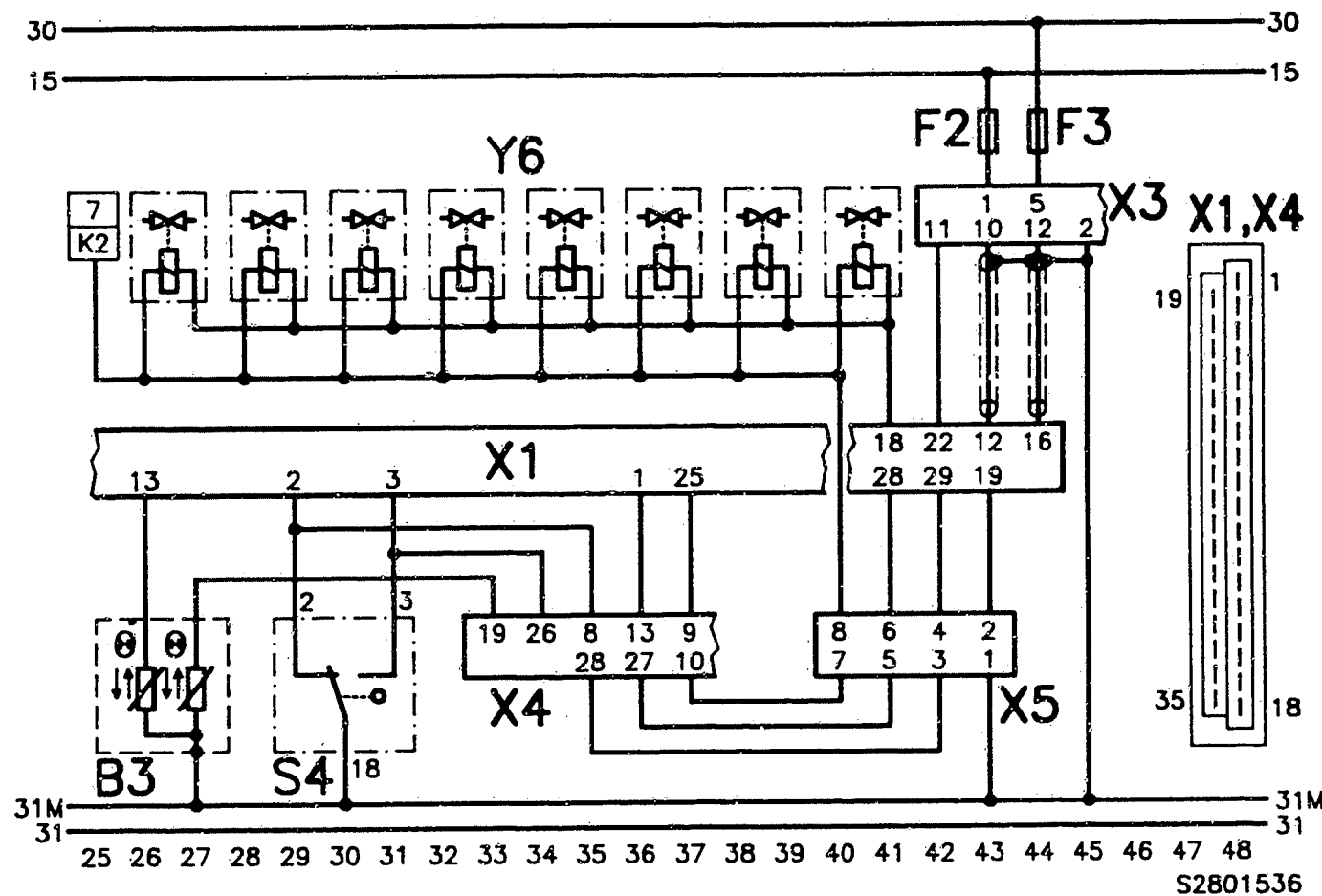
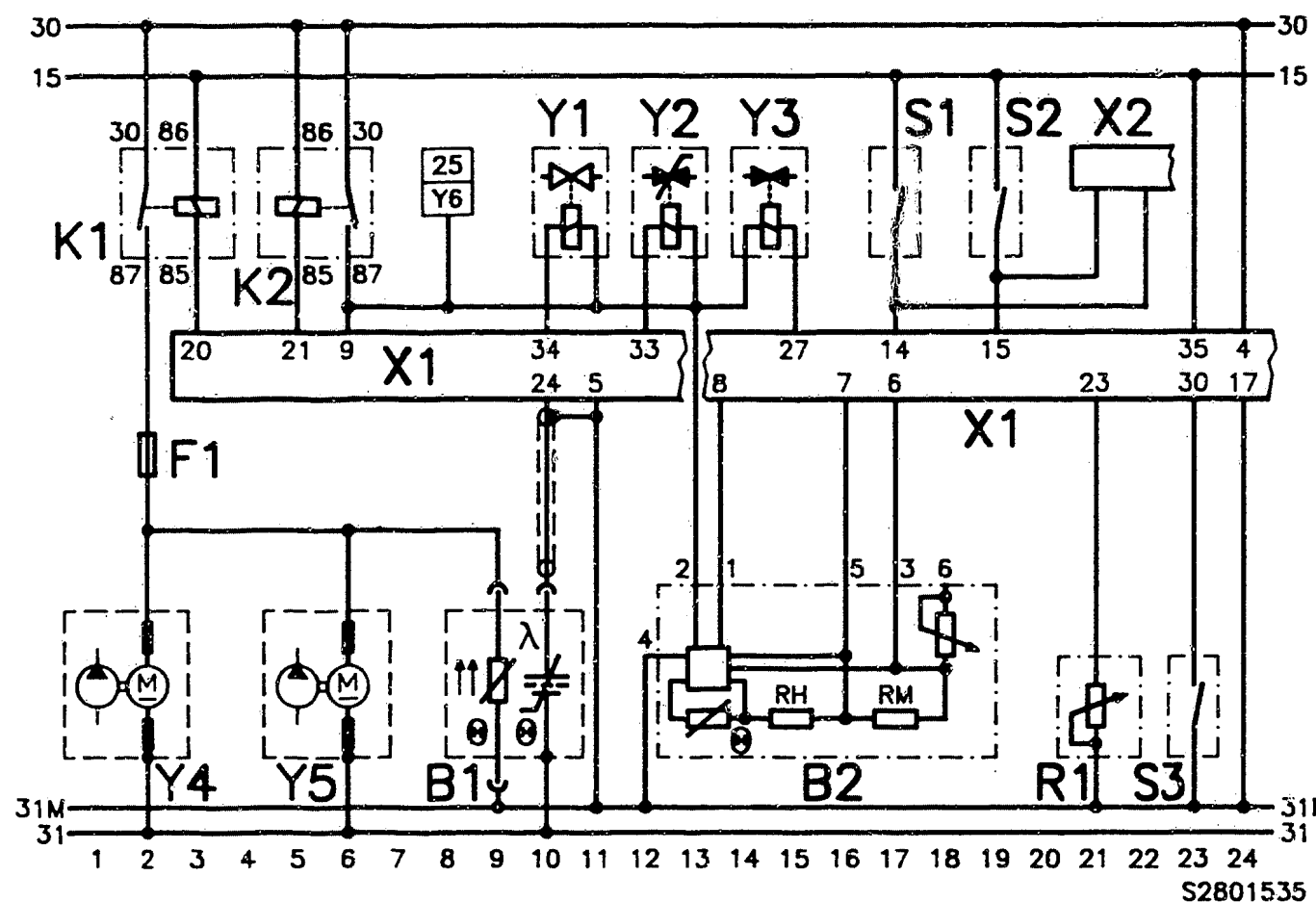
TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
Lambda closed-loop control (Test with tester 0 684 101 810)	Sensor voltage
* Open-loop control (press both Fixed voltage value approx. buttons 0.1 V and 0.9 V):	0.1 V or approx. 0.9 V
* Closed-loop control (do not press button):	Reading fluctuates between 0.1 V and 0.9 V
* Adjustment:	Not necessary in view of adaptive lambda clsd.-lp.ctrl.

* Rich value (press 0.1 V button for lean simulation):	Approx. 0.9 V
* Lean value (press 0.9 V button for rich simulation):	Approx. 0.1 V

Please refer to equipment and Autodata
microcard for settings as regards ignition,
valve clearance and other engine-related data.

For production reasons:
continued on the following
coordinate.



B1 = Heated lambda sensor
 B2 = Hot-wire air-mass meter
 B3 = Twin temperature sensor
 K1 = Pump relay
 K2 = Main relay
 R1 = Idle potentiometer
 S1 = A/C compressor switch

S2 = A/C readiness switch
 S3 = Drive switch (automatic only)
 S4 = Throttle-valve switch
 X1 = Jetronic control-unit plug
 X2 = A/C plug
 X3 = Diagnosis plug
 X4 = Ignition control-unit plug

X5 = Encoding connection
 Y1 = Intake-manifold resonance flap
 Y2 = Idle actuator
 Y3 = Tank ventilation valve
 Y4 = Pre-supply pump
 Y5 = Electric fuel pump
 Y6 = Solenoid-operated injection valves

ELECTRICAL TERMINAL DIAGRAM Porsche 928 S4

J21 —————>

J22 <—————

INSTALLATION POSITION OF COMPONENTS

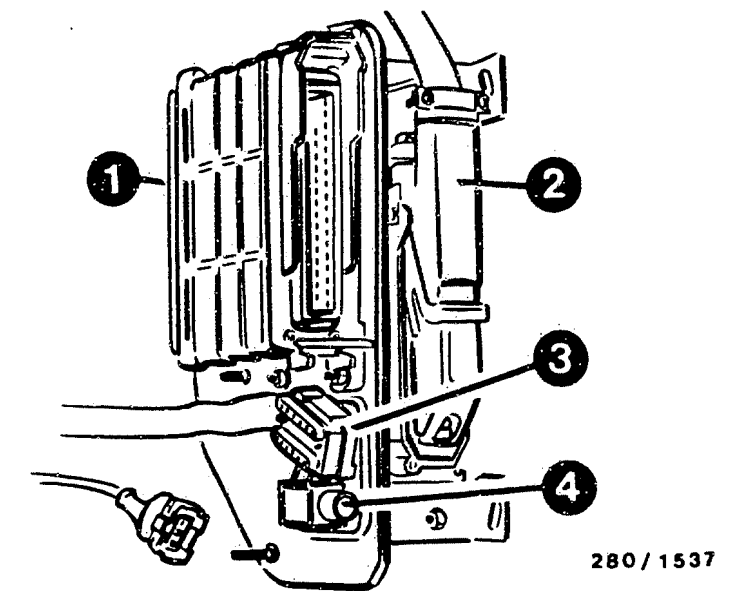
The installation locations always refer to the direction of travel.

* Top picture

The EI-K control unit (1) and the LH control unit (2) are located in the passenger-side footwell on the right, behind a cover.

The diagnosis connection (3) is located at the control-unit retaining plate.

Located beneath this is the separate idle CO potentiometer (4) in vehicles with no lambda closed-loop control.



* Center picture

The central electrics console is located in the passenger-side footwell. The console becomes accessible after folding back the mat and swivelling the floor board upwards.

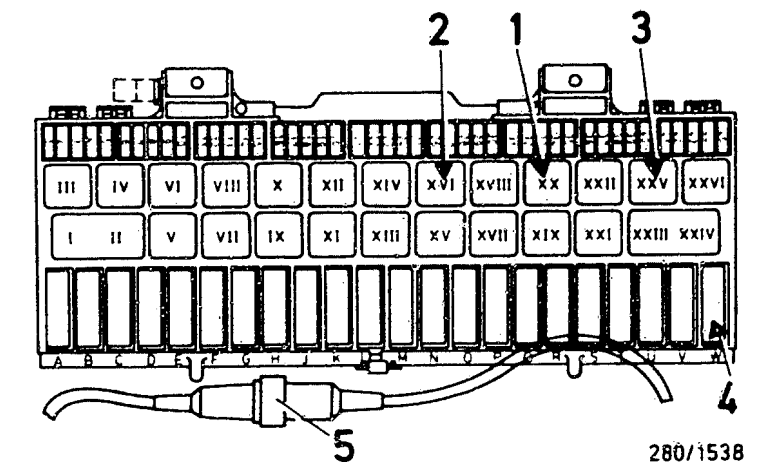
1 = Pump relay for LH-Jetronic

2 = Relay for EI-K control unit

3 = Main relay for LH-Jetronic

4 = Plug for voltage supply of EI-K and LH control unit.

5 = Lambda-sensor plug connection

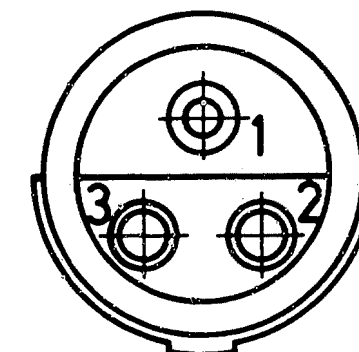


* Bottom picture

Assignment of lambda-sensor plug

1 = Sensor voltage, black lead

2,3 = Heater, white leads



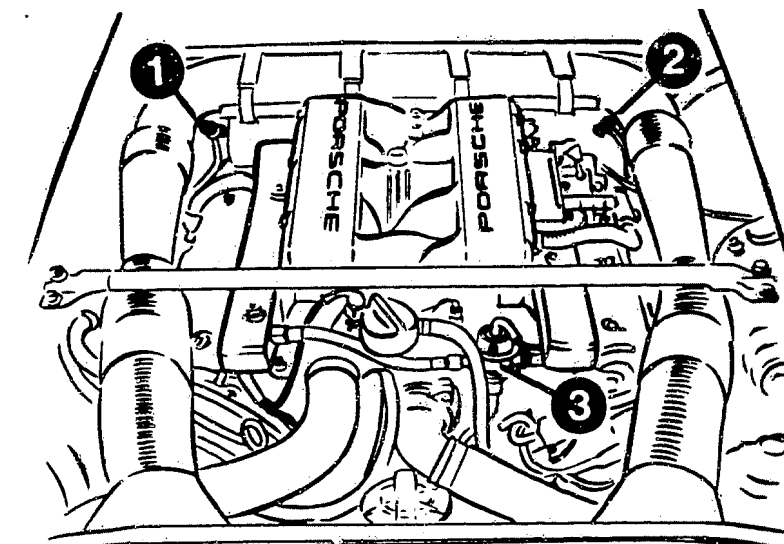
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INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Components on engine

* Top picture

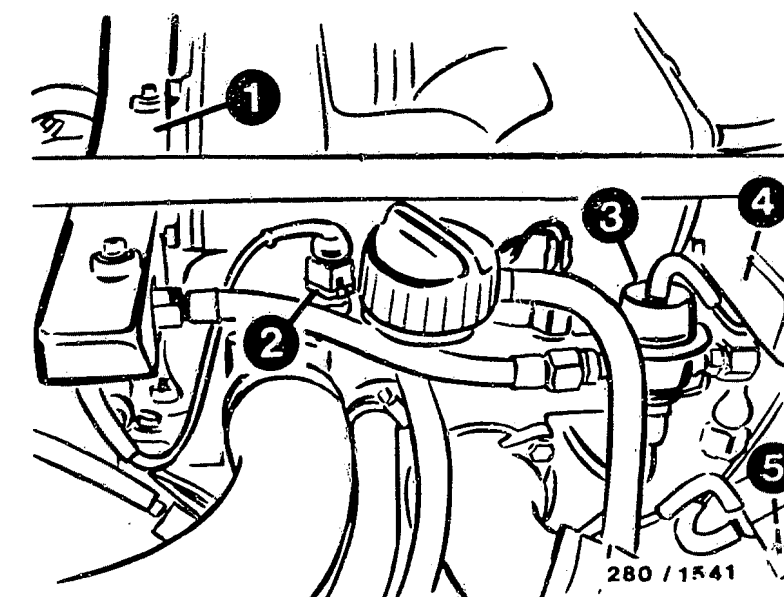
- 1 = CO sampling point for right-hand cylinder bank
- 2 = CO sampling point for left-hand cylinder bank
- 3 = Fuel pressure regulator



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* Center picture

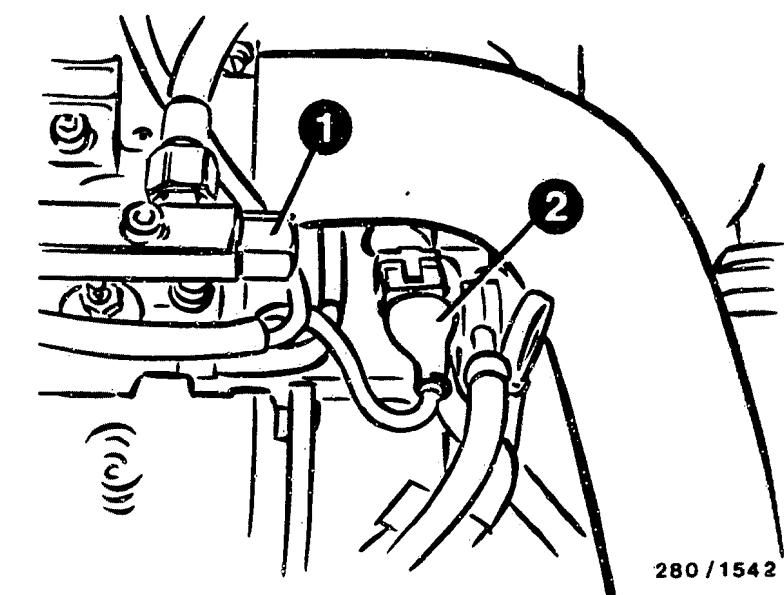
- 1 = Right-hand fuel-distribution pipe with solenoid-op. inj. valves
- 2 = Twin temperature sensor (engine) for Jetronic and EI-K control unit.
- 3 = Fuel pressure regulator
- 4 = Left-hand fuel-distribution pipe with solenoid-operated inj. valves
- 5 = Solenoid valve for intake-manifold resonance flap



280 / 1541

* Bottom picture

- 1 = Right-hand fuel-distribution pipe with solenoid-operated inj. valves
- 2 = Tank ventilation valve

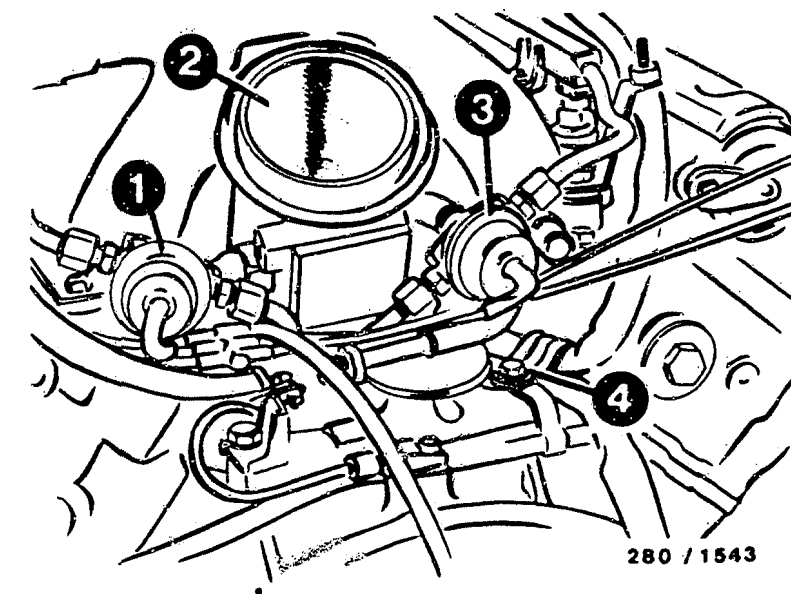


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INSTALLATION POSITION OF COMPONENTS (CONTINUED)

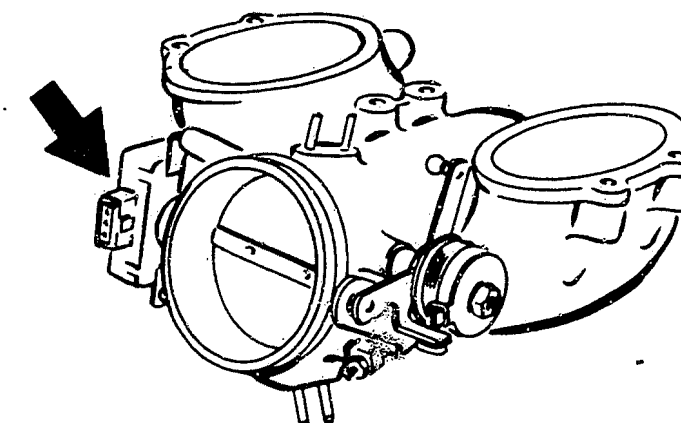
* Top picture

- 1 = Fuel pressure regulator
- 2 = Hot-wire air-mass meter
- 3 = Fuel pressure regulator
- 4 = Electrics ground



* Center picture

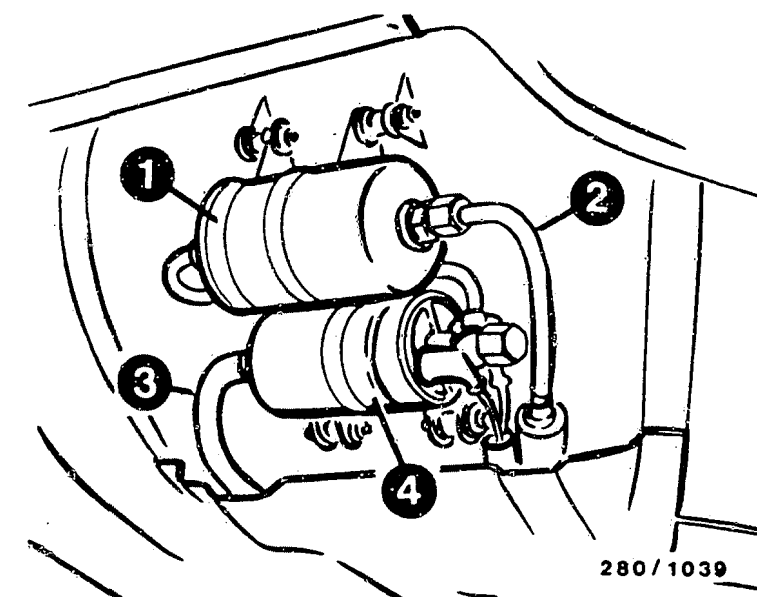
Arrow indicates throttle-valve switch on removed throttle-valve assembly (time required for removal approx. 6 hours).



Fuel-supply components

* Bottom picture

- 1 = Fuel filter
- 2 = Fuel delivery line
- 3 = Fuel intake line
- 4 = Electric fuel pump



Trouble-shooting instructions: LAI-5001

BOSCH system : L3.2 -Jetronic

Make of vehicle : LANCIA

Basic microcard : PKW-118

Section	Coordinates
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Special features.....	02
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Structure, usage.....	03
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Safety and precautionary measures.....	03
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Trouble-shooting chart.....	04
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Rapid diagnosis chart.....	05
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Test specifications.....	11
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Electrical terminal diagram.....	15
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Installation position of components.....	17
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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle model:

LANCIA Y 10 1.3 i.e.
with 1.300 l / 4-cyl. engine
A, CH, D, S - versions

11.87->

* L3.2 Jetronic with 15-pole control unit:
0 280 000 610

* Engine-speed triggering from term. 1 of ignition coil.

* Control unit attached directly to air-flow sensor.

* Air-flow sensor connected to control unit via an internal 4-pole plug connection.

* CO adjusting screw on control unit.

* Actuation of electric fuel pump by control unit via pump relay.

* Supply voltage for control unit via main relay.

* Lambda closed-loop control

* Start control, i.e. additional quantity of fuel injected by way of all injection valves.

* Tank ventilation system with active-carbon container and vacuum-controlled tank ventilation valve.

* Use is to be made of pressure gauge and tubing of pressure measuring device KDJE-P 100 for testing fuel pressure.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.
2. Engine starts but then dies.
3. Idle problems (engine speed, exhaust gas).
4. Poor throttle take-up, flat spot during acceleration.
5. Engine missing (ignition, injection).
6. Maximum engine power/top speed not reached.
7. Fuel consumption too high.
8. Engine running on (dieseling).
9. Engine pinging/knocking.
10. Engine overheating.
11. Fault lamp.

Cause (component fault)									
*	*	*	*	*	*	*		*	Universal test adapter
*	*	*	*		*				Air-intake system
*	*	*	*						Auxiliary-air device
*		*	*	*	*	*			Air-flow sensor
				*	*				Fuel delivery
*	*	*	*		*	*	*		Fuel pressure, leaks
		*							Pump noise
		*		*	*	*	*		Solenoid-operated injection valves
				*					Alternator, interference suppression
*	*	*				*			Start control
				*		*			Overrun cutoff
		*	*	*		*			Engine-speed, CO adjustment
		*	*	*	*				Lambda closed-loop control
					*				Catalytic converter

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 168

Test step	Switch		Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
	V	Ω				
1	 V	5	8 - 5	Resistance of temperature sensor (engine)	Only connect control-unit plug Engine temperature +15...+30 °C : approx. +80 °C :	1.45...3.3 k Ω 280...360 Ω
2	 V	6	4 - 5	Ground connection of output stage		0...10 Ω
3	 V	7	6 - 5	t v encoding	Connect end of lead from term. 6 to ground	0...10 Ω
4	 V	9	15 - 5	Throttle-valve switch/ resistance of idle contact	Throttle valve closed : Open throttle valve :	0...10 Ω infinity Ω
5	 V	10	14 - 5	Throttle-valve switch/ resistance of full-load contact	Throttle valve closed : Open throttle valve completely:	infinity Ω 0...10 Ω
6	5	10	1 - 5 (+) (-)	Term. 1 signal from ignition coil term. 1	Transmission in neutral, start engine	Ignition pulses on oscilloscope
7	6	10	2 - 5 (+) (-)	Voltage supply of control unit	Switch on ignition	8...15 V
8	7	10	12 - 5 (+) (-)	Winding of pump relay	Switch on ignition	8...15 V

K05

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K06

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RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

Adapter lead: 1 684 463 168

Test step	Switch		Terminals	Testing of component/function	Test instructions/ test conditions	Set values
	V	Ω				
9	7	10	12 - 5	Simulation of electric-fuel-pump actuation	Detach connector from auxiliary-air device Switch on ignition Press test button 3	Electric fuel pump should be heard to run
9.1	7	10	12 - 5	Simulation of auxiliary-air-device actuation	Attach connector to auxiliary-air device Switch on ignition Press test button 3	Perform visual inspection to see whether air cross-section is closed off
10	7	10	12 - 5 (+) (-)	Ground actuation of pump relay term.85 by control unit	Connect up control unit Transmission in neutral, start engine Allow engine to idle	0...5 V
11	8	10	11 - 5 (+) (-)	Air-flow signal U _p output term. 11	Run engine	0...5 V load-dependent
12	9	10	7 - 5 (+) (-)	Jumper from term.7 to term.2	Run engine	8...15 V
13	10	10	3 - 5 (+) (-)	Injection pulses from control unit	Run engine	Injection pulses on oscilloscope
14	11	10	10 - 5 (+) (-)	Sensor monitoring	Run engine	0...1.0 V
15	12	10	9 - 5 (+) (-)	Reference voltage U _v output term. 9	Run engine	3.5...4.5 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)
 Adapter lead :1 684 463 168

Test step	Switch		Termi- nals	Testing of component/function	Test instructions/ test conditions	Set values
	V	Ω				
16	10	10	3 - 5 (+) (-)	Simulation of cold engine	Run engine, press test button 1	Injection pulse wider or engine speed lower
17	10	10	3 - 5 (+) (-)	Simulation of warm engine	Run engine, press test button 2	Injection pulse must not become wider
18	10	10	3 - 5 (+) (-)	Overrun-cutoff simulation	Run engine, engine speed in excess of 2000 min ⁻¹ Press test button 5	No injection pulses, engine hunts
19	10	10	3 - 5 (+) (-)	Simulation of full-load correction	Run engine, engine speed approx. 2400 min ⁻¹ Press test button 6	Slight change in injection pulse/ engine speed
20	11	10	10 - 5 (+) (-)	Measurement output - lambda closed-loop control (mixture adjustment)	Run engine Press test button 4 Turn CO adjusting screw until voltage reading fluctuates uniformly between 0...13 V.	0...13 V fluctuating

TEST SPECIFICATIONS

Components/operation	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 550 cm ³ /30 s
* Supply voltage under load:	at least 12V
Pressure regulator	
* Fuel pressure with engine not running:	2,3...2,7 bar
at idle speed:	approx. 0.5 bar lower
Fuel system, leakage	
* Fuel pressure 20 min. after engine switched off:	at least 1.0 bar
Auxiliary-air device	
* Internal elec. resistance:	40...75 Ω
Air-flow sensor, only measurable if control unit is removed.	
* Resistance value between term.3- and term.4- :	500...1000 Ω
term.3- and term.2- :	
Air-flow sensor flap in rest position	10...200 Ω
When air-flow sensor flap is deflected, indication must change:	
Temperature sensor (intake air), only measurable if control unit is removed.	
* Internal electrical resistance, between term.3- and term.1-, at ambient temperature +15...+30 °C:	1.45...3.3 k Ω

TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
Temperature sensor (engine)	
* Internal resistance at ambient temperature +15...+30 °C :	1.45...3.3 k Ω
with engine at operating temperature approx. +80 °C :	280...360 Ω
Solenoid-operated injection valve	
* Internal resistance at ambient temperature +15...+30 °C :	14,5...17,5 Ω
* Leakage after 60 s:	no droplet may drip off
Start control	
* Voltage at injection valve Start initiation :	approx. 1.5 V
after approx. 15s:	approx. 0.5 V
Idle-speed adjustment	
Engine at operating temperature, approx. +80°C	
* Idle speed:	800...900 min ⁻¹

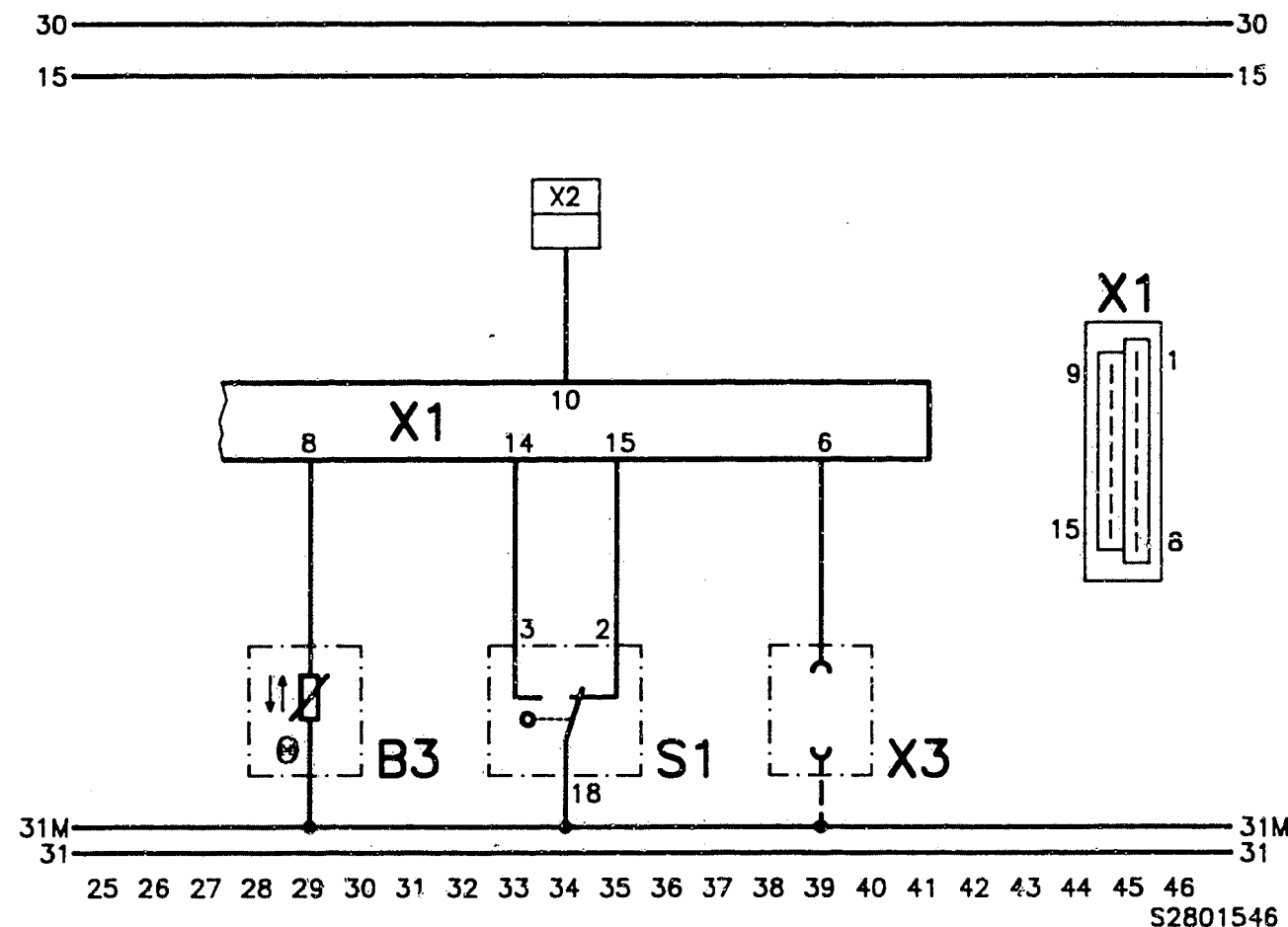
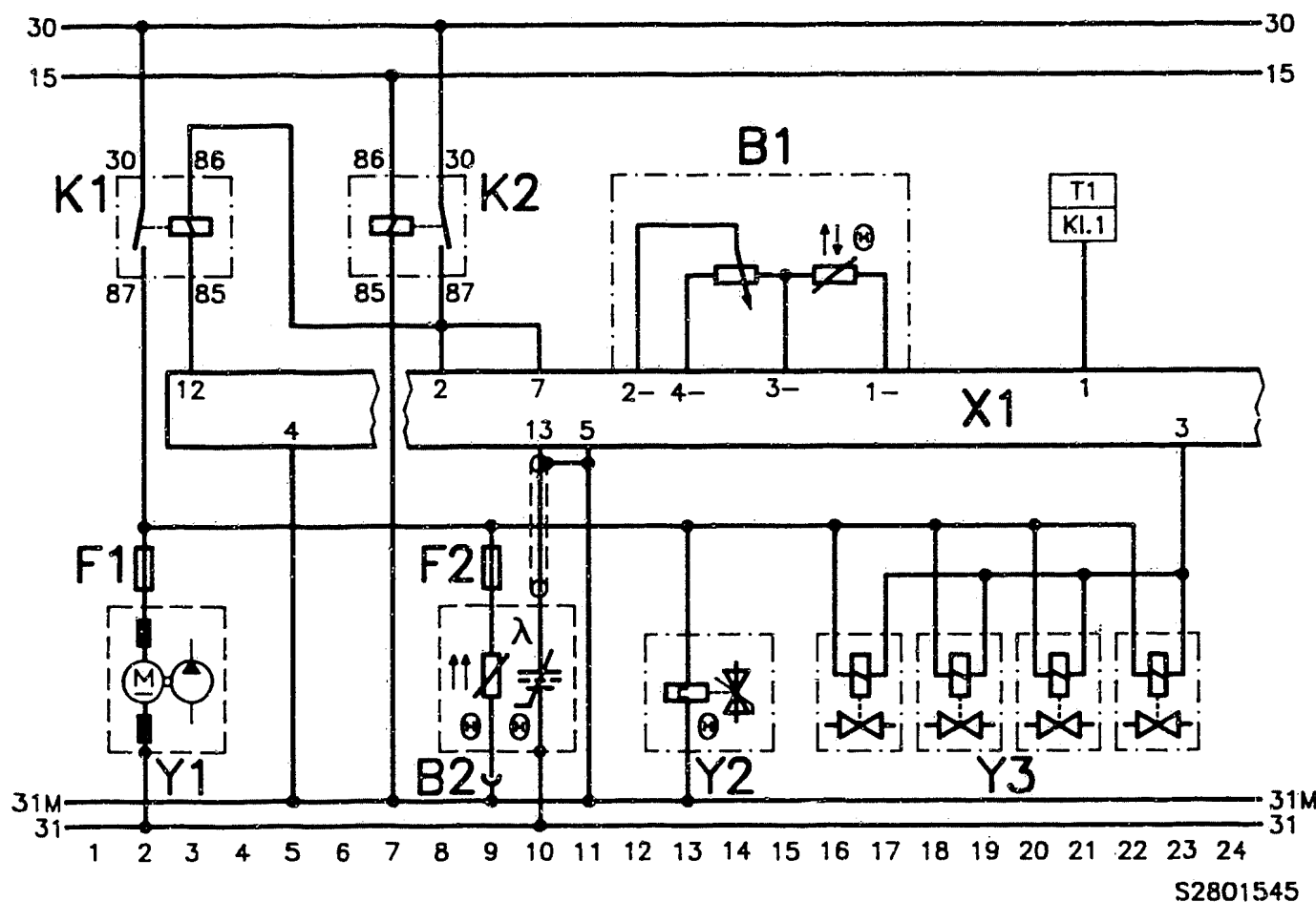
TEST SPECIFICATIONS (CONTINUED)

Component/function	Set values
CO adjustment	
Engine at operating temperature, approx. +80°C	
Short-circuit idle and full-load switch to vehicle ground.	
Integrator voltage	
(Test pin term.10)	
* Open-loop control (disconnect plug connection of sensor lead):	Fixed voltage value between 10...13 V
* Closed-loop control (connect plug connection):	Reading fluctuates between 0...13 V
* Setting:	Reading fluctuating uniformly betw. 0...13V

* Rich value (disconnect plug connection and connect control-unit lead to ground):	10...13 V
* Lean value (apply 2V to control-unit lead):	less than approx. 1.0 V

For production reasons:
continued on the following
coordinate.

Refer to equipment and Autodata microcard for settings as regards ignition and valve clearance as well as for other engine-related data.



B1 = Air-flow sensor with
temperature sensor (intake air)
B2 = Heated lambda sensor
B3 = Temperature sensor (engine)
F1 = Fuse for sensor heater
F2 = Pump fuse
K1 = Main relay

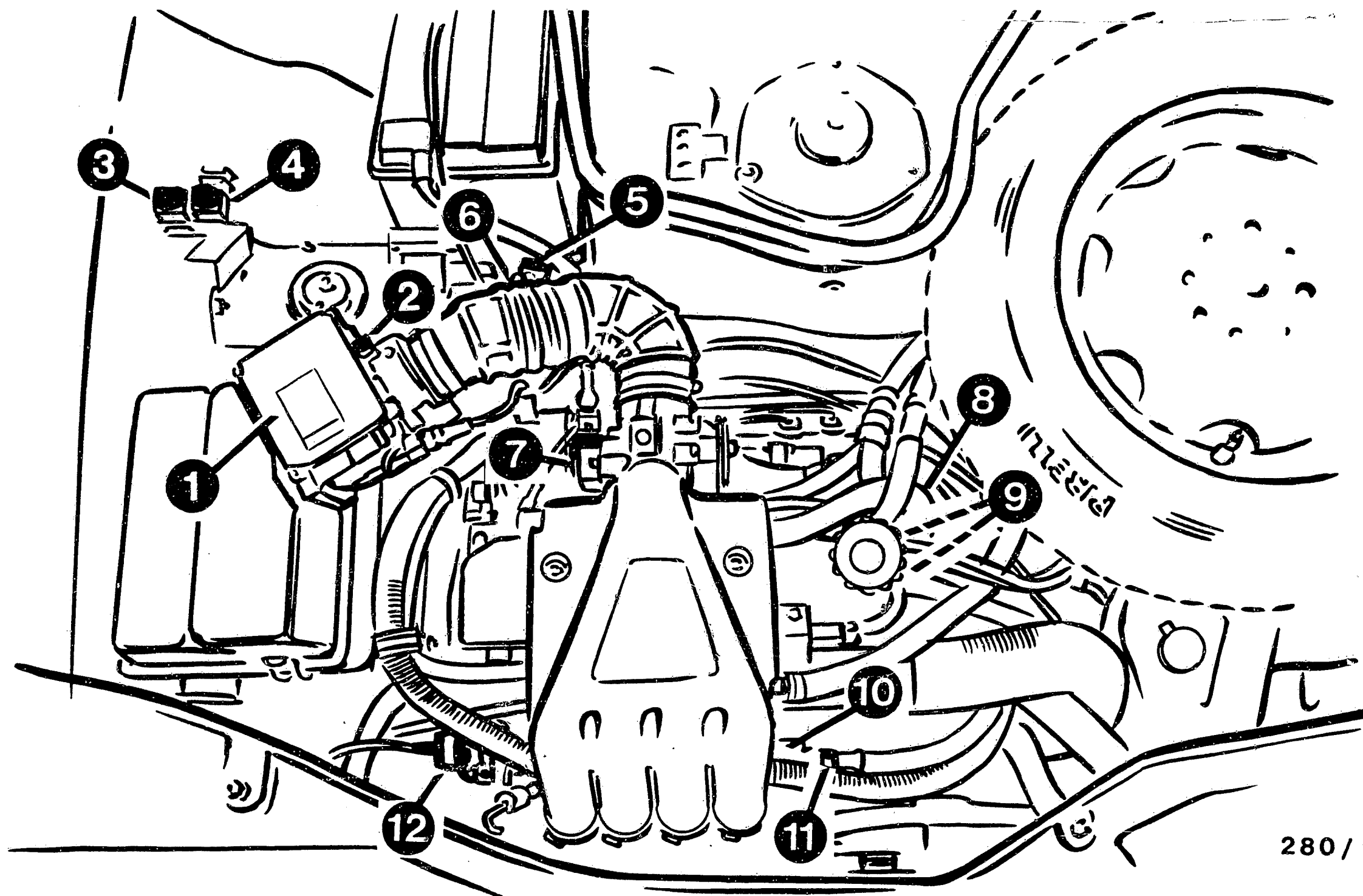
K2 = Pump relay
S1 = Throttle-valve switch
X1 = Jetronic control-unit plug
X2 = Control-unit plug (ignition)
X3 = U_v output, reference voltage
X4 = Test output for lambda closed-loop
control and diagnosis output

X5 = U_p output, air-flow signal
X6 = t_v coding or diagnosis stimulation
Y1 = Electric fuel pump
Y2 = Auxiliary-air device
Y3 = Solenoid-operated injection valves

ELECTRICAL TERMINAL DIAGRAM

K15 — ==>

K16 — <==



280 / 1547

- 1 = Meas. and ctrl. facility consisting of air-flow sensor and ctrl. unit
- 2 = CO adjustment potentiometer (Lambda closed-loop control)
- 3 = Main relay

- 4 = Pump relay
- 5 = Plug for lambda sensor
- 6 = Plug for sensor heater
- 7 = Throttle-valve switch
- 8 = to auxiliary-air device

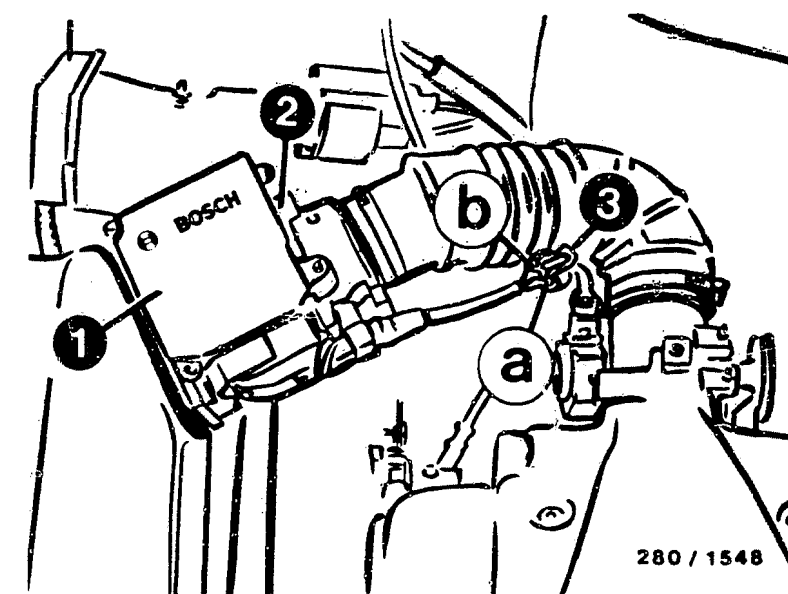
- 9 = to temperature sensor (engine)
- 10 = Solenoid-operated injection valves
- 11 = Pressure measurement connection
- 12 = Pressure regulator

INSTALLATION POSITION OF COMPONENTS

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

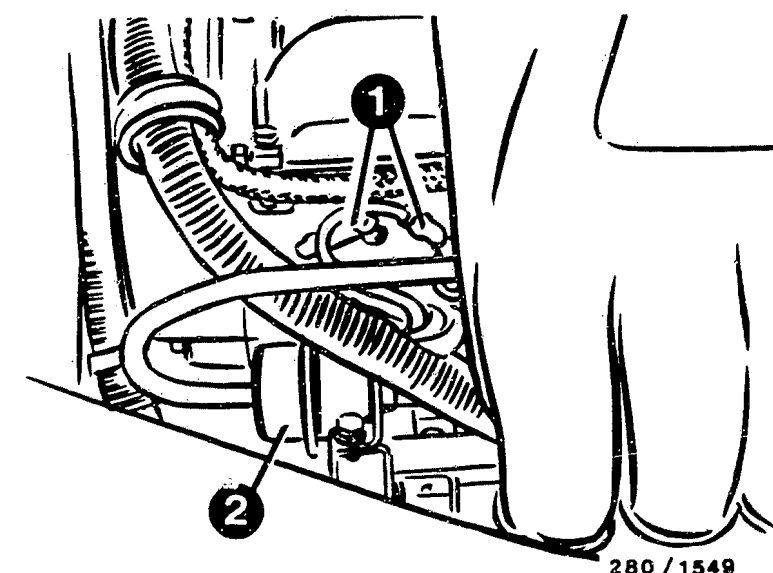
* Top picture

- 1 = Measurement and control facility consisting of air-flow sensor and control unit
- 2 = CO adjustment potentiometer (lambda closed-loop control)
- 3 = 3-pole test connection
 - a = Test pin term. 10 (integrator voltage)
 - b = Connection term. 6 (t v encoding)



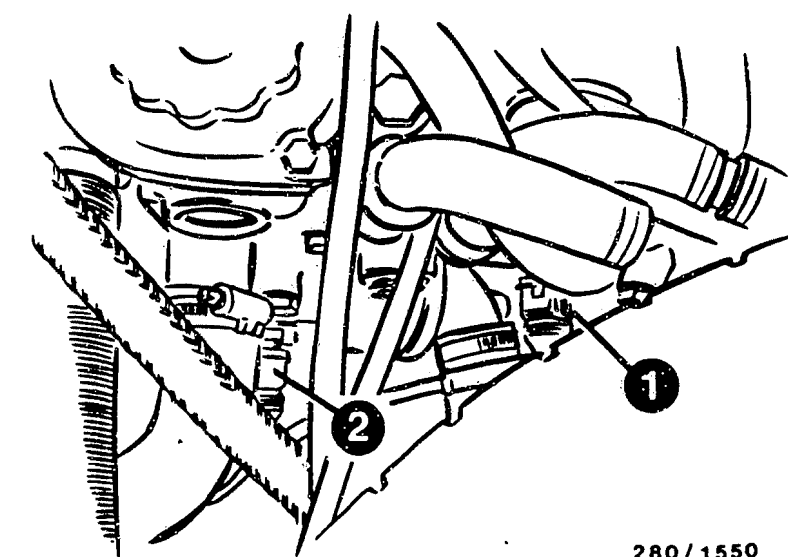
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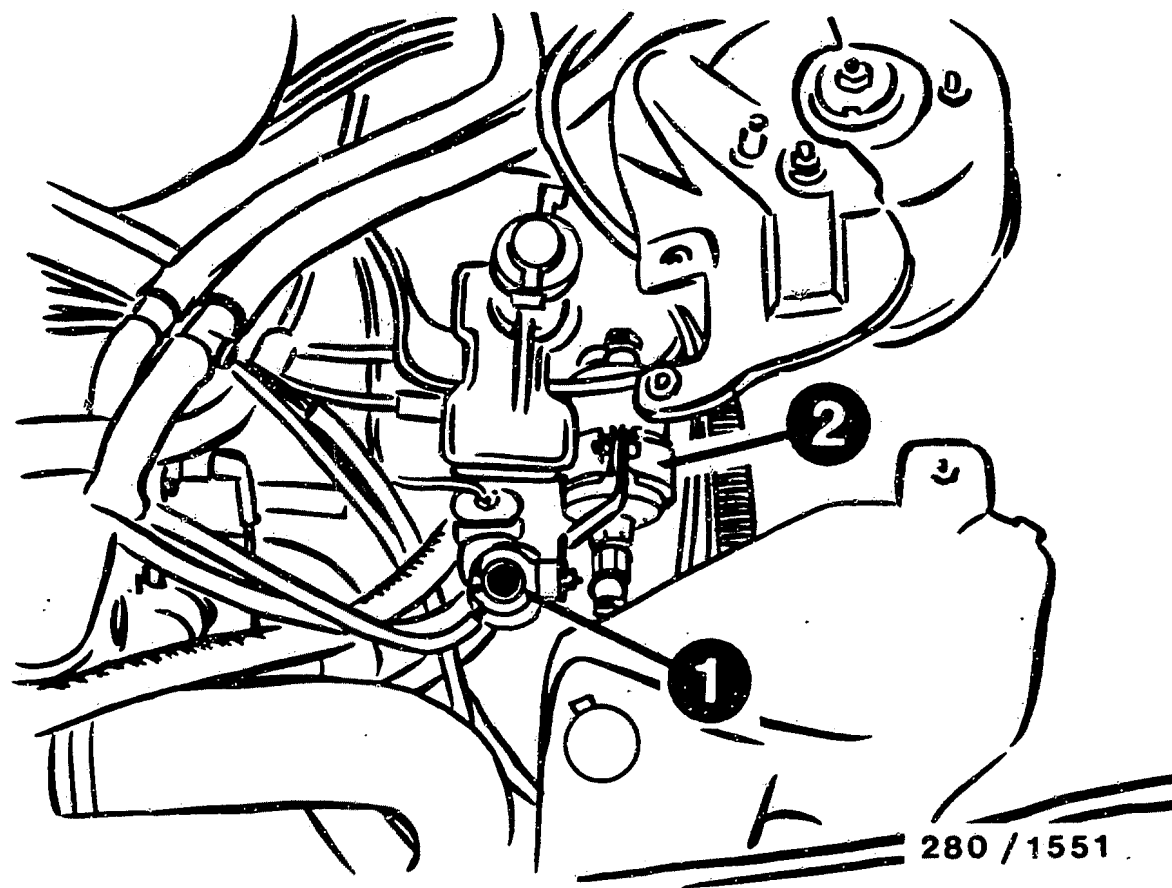
- 1 = Central ground
- 2 = Pressure regulator



* Bottom picture

- 1 = Auxiliary-air device
- 2 = Temperature sensor (engine)





INSTALLATION POSITION OF COMPONENTS (CONTINUED)

- 1 = Tank ventilation valve
- 2 = Fuel filter

Both components are located on the left-hand side in the engine compartment beneath the spare wheel.

The installation locations always refer to the direction of travel.

- * Heated lambda sensor:
In exhaust pipe ahead of catalytic converter.
- * Active-carbon container:
On left-hand side behind front bumper.
- * Electric fuel pump is designed as an in-tank pump.

For production reasons:
continued on the following
coordinate.

Trouble-shooting instructions : MB-5048

BOSCH system : M-pump with RSF governor

Make of vehicle : MB

Basic microcard : ME-511

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Mercedes-Benz models

- 190 D 2.5 (type 201)
- 250 D (type 124)
- 300 D (type 124)

9.87 ->
with active bucking damping (ARD)

Engine: OM 602.. / 603 ..
EU/S - Standard
with mechanical transmission

Vehicles of the country version - Switzerland -
are additionally equipped with an exhaust-
gas recirculation system.

USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart gives an indication of various causes/component faults.

Detailed trouble-shooting information is given in the trouble-shooting chart in the basic instructions.

TEST SPECIFICATIONS

Idle speed:

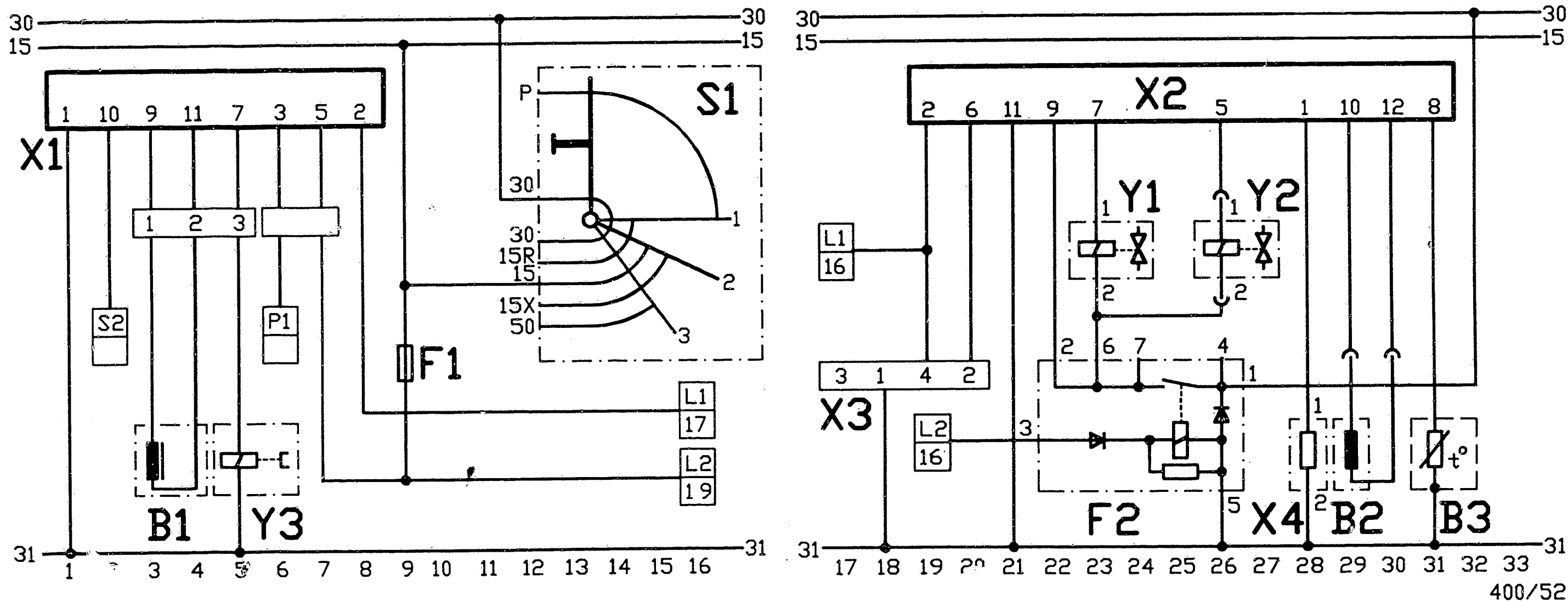
Engine	Pneumatic idle increase	Regulated	Unregulated..
602	650...750		
603.912		610...650	530...610
603.913		660...700	530...610
4Matic			

Individual trimming plugs:

Part No.	Resistance	Complaint
000 540 2981	100 Ω	Part-load bucking
000 540 2281	220 Ω	
000 540 2381	470 Ω	
000 540 2581	1300 Ω	Poor acceleration
000 540 2681	2400 Ω	
000 540 2781	4700 Ω	

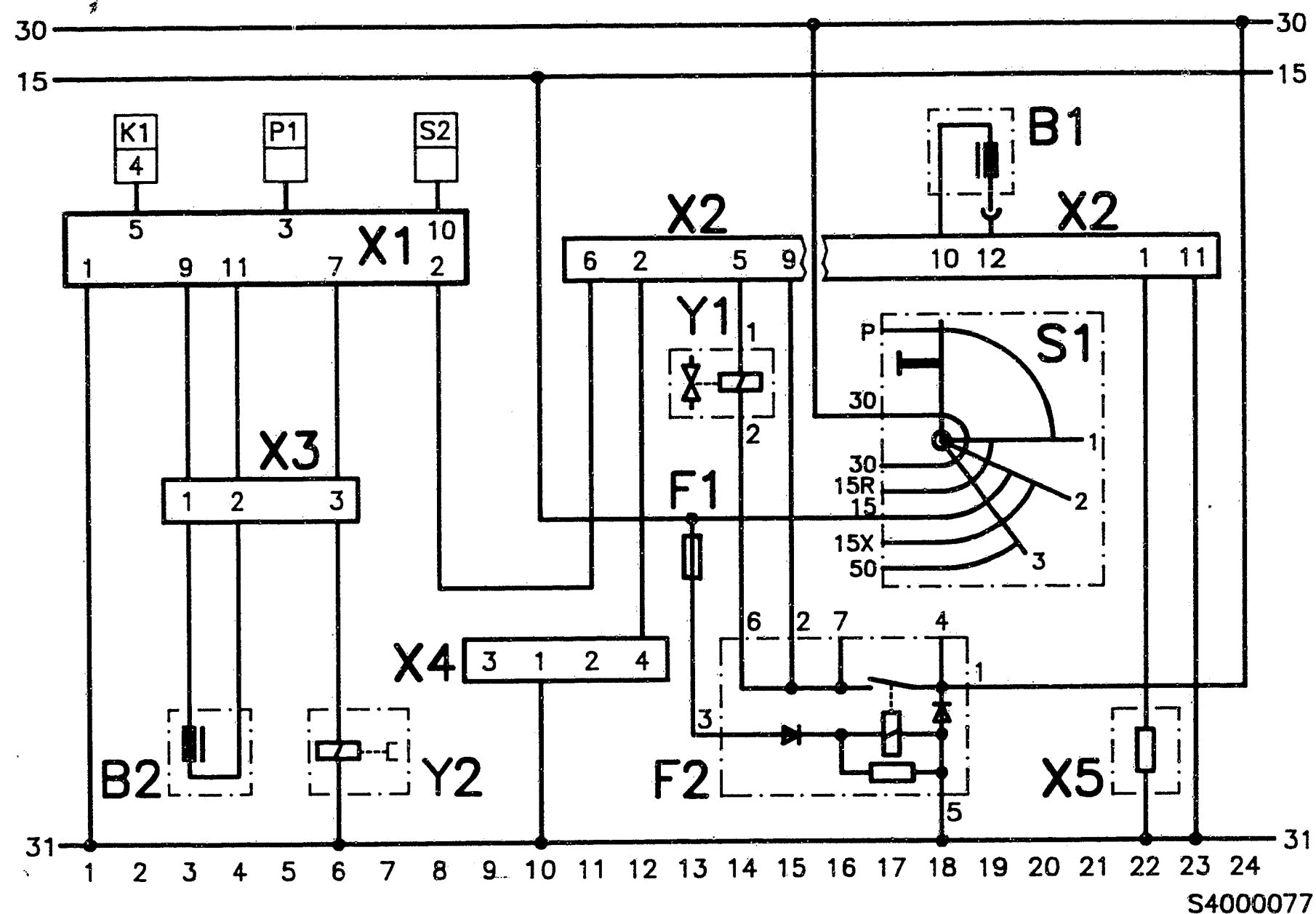
TESTERS AND TOOLS

Name	Designation	Part no.
Evaluation unit for flashing-code diagnosis		KDAW 9980
Ohmmeter	ETE 014.00	0 684 101 400
Voltmeter	ETE 014.00	0 684 101 400



- | | |
|--|--|
| B1/Y3 = Refrigerant compressor | X1 = Control unit, refrigerant-compressor cutoff |
| B2 = Eng.-speed sensor, starting-motor ring gear | X2 = Control unit, idle-speed regulation (ARD) |
| B3 = Coolant temperature sensor | Active bucking damping |
| F1 = Central electrics console | X3 = Test coupling for flashing-code diagnosis |
| F2 = Over-voltage protection | X4 = Individual trimming plug (as required) |
| P1 = Rev. counter | Y1 = Servo magnet, electronic |
| S1 = Glow-plug and starter switch | idle-speed regulation (ELR) |
| S2 = Pressure switch, refrigerant compressor | Y2 = Servo magnet, active bucking damping (ARD) |

ELECTRICAL TERMINAL DIAGRAM TYPE 124 ENGINE 603 WITH ELR/ARD AND AUTOMATIC AIR CONDITIONING



S4000077

- | | | | |
|-------|---|----|--|
| B1 | = Engine-speed sensor, starting-motor ring gear | S2 | = Pressure switch, refrigerant compressor |
| B2/Y2 | = Refrigerant compressor | X1 | = Control unit, refrigerant-comp. cutoff |
| F1 | = Central electrics console | X2 | = Control unit, act. bucking damping (ARD) |
| F2 | = Relay, over-voltage protection | X4 | = Test coupling for flashing-code diag. |
| K1 | = Relay, auxiliary fan | X5 | = Individual trimming plug (as required) |
| P1 | = Rev. counter | Y1 | = Servo magnet, act. bucking damping (ARD) |
| S1 | = Glow-plug and starter switch | | |

ELECTRICAL TERMINAL DIAGRAM TYPE 201 ENGINE 602 WITH ARD AND AUTOMATIC AIR CONDITIONING

Customer complaint (fault symptoms)

- Cause (component fault)**

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Customer complaint (fault symptoms)

- Cause (component fault)**

L10

FLASHING-CODE EVALUATION

Connect socket 3 of evaluation unit for flashing-code diagnosis KDAW 9980 to a fused positive lead.

Connect socket 4 to socket 1 of evaluation unit.

Connect socket 2 to socket 4 of diagnosis socket.

Start engine.

Actuate nonlocking switch (evaluation unit) for between 2 and 4 seconds.

Then keep nonlocking switch pressed.

Flashing code of corresponding faulty component is indicated.

Repeat flashing-code evaluation:

Briefly disconnect plug connection (socket 4, diagnosis socket).

Press nonlocking switch.

Scan flashing code.

SELF-DIAGNOSIS TEST PROGRAM

Breakdown of self-diagnosis (flashing code)

- ```

1 x All functions O.K.
2 x Engine-speed sensor
3 x Coolant temperature sensor
5 x Closed loop, active bucking damping (ARD)*
6 x Closed loop, idle increase
 (ELR)*

```

\* Only short-circuit faults are detected

**Test conditions:**

- Coolant temperature 60...80°C
- Fuse of over-voltage protection  
O.K.
- Mechanical transmission:  
Battery voltage at least 11.5 V between  
socket 1 and socket 5 of over-voltage protection.
- Automatic transmission:  
Battery voltage at least 11.5 V. Selector  
lever in position "P".
- A/C off
- All plug connections made.
- Idle speed

| Engine  | Pneumatic<br>idle<br>increase | Regulated | Unreg.    |
|---------|-------------------------------|-----------|-----------|
| 602     | 650...750                     |           |           |
| 603.912 |                               | 610...650 | 530...610 |
| 603.913 |                               | 660...700 | 530...610 |
| 4Matic  |                               |           |           |

# SELF-DIAGNOSIS TEST PROGRAM ( 1 )

Flashing code "2"

Component: Engine-speed sensor

In engine compartment next to battery

Test 1: Ground connection

Detach multiple butt connector from engine-speed sensor.

Connect ohmmeter with commercially available test prods to one wiring post in each case and ground.

Set value:  $> 1 \text{ M } \Omega$

Set value attained?

Engine-speed sensor defective,  
renew.

Test 2: Internal resistance

Detach multiple butt connector from engine-speed sensor.

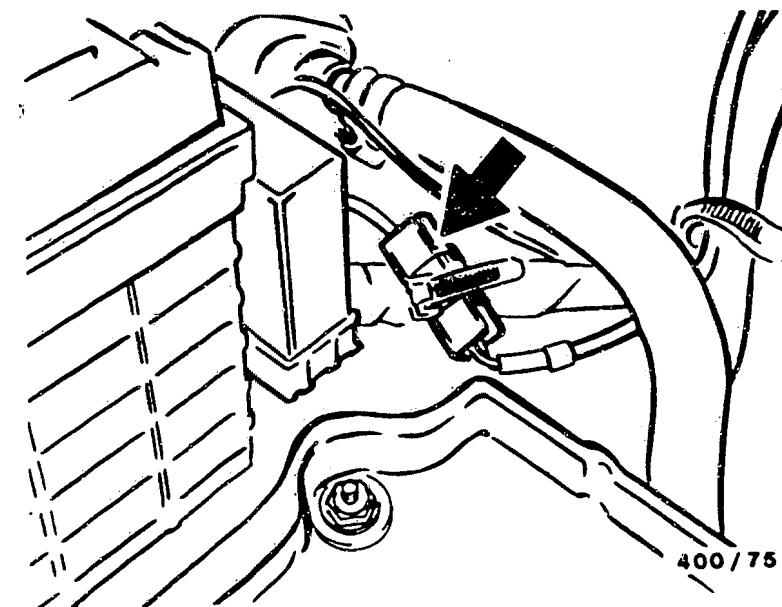
Connect ohmmeter to pins of multiple butt connector.

Set value:  $1.7 \dots 2.1 \text{ K } \Omega$

Set value outside tolerance

Engine-speed sensor defective,  
renew.

Continued on next picture page



SELF-DIAGNOSIS TEST PROGRAM ( 1 ) (CONTINUED 1)

Test 3:

Check to see whether engine-speed sensor is dirty.

N>

Detach multiple butt connector from engine-speed sensor.  
Connect test lead to both wiring posts.

Allow engine to idle.

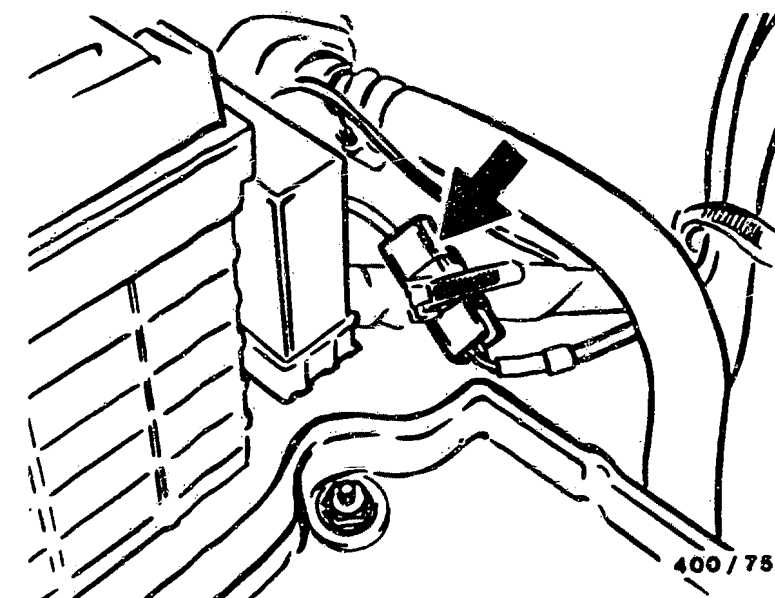
Set value : > 4 V AC

Note:

Voltage increases with increasing engine speed.

Is set value attained?

Check to see whether dirt has accumulated on engine-speed sensor and clean if necessary.  
Eliminate open-circuit in lead.  
Renew control unit.



Continued on next picture page



# SELF-DIAGNOSIS TEST PROGRAM ( 2 )

Flashing code "3"

Component: Water temperature sensor

N>

Water temperature sensor defective,  
renew.

Test 1: Resistance

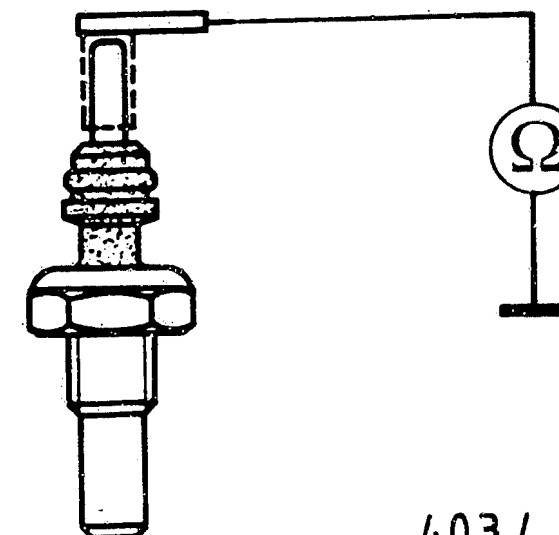
Engine switched off. Detach  
connector at temperature sensor.  
Test ohmmeter with test lead with  
respect to ground (top picture).

See diagram for set values.

Set value at:

+ 20 °C = 2200...2800 Ω

+ 80 °C = 290...370 Ω



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Test 2: Voltage supply.

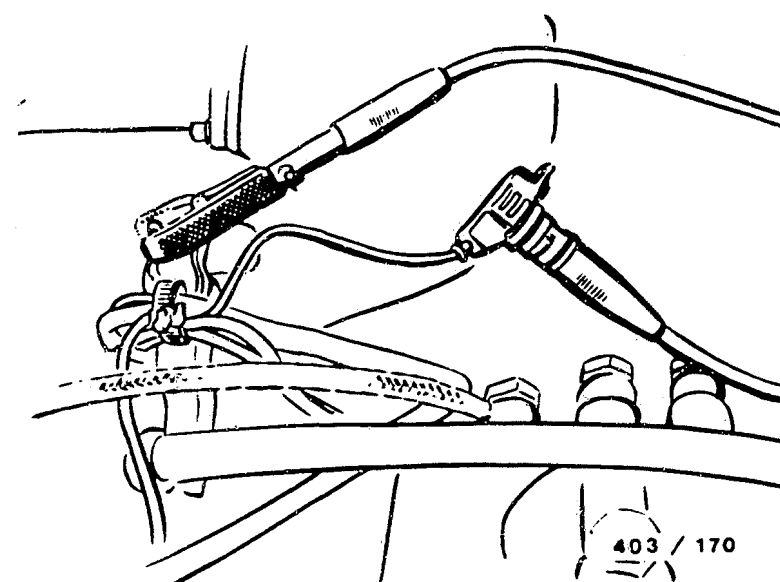
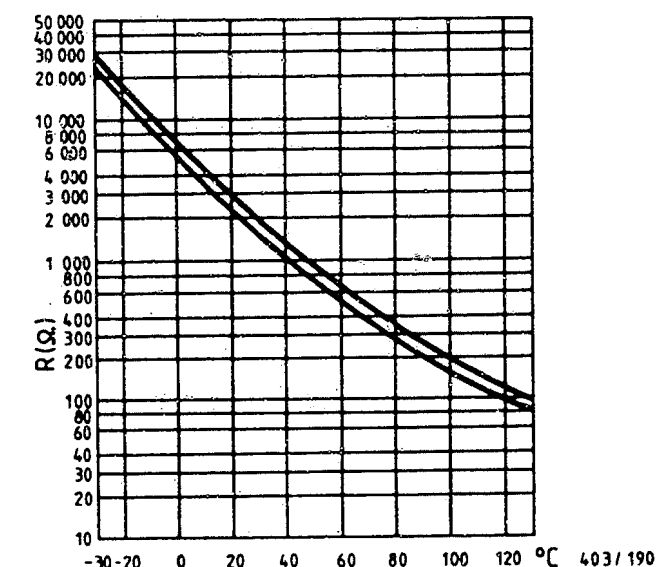
Detach connector at water  
temperature sensor.  
Connect voltmeter with commercially  
available test lead to 1-pole plug.  
Switch on ignition.

N>

Test for open-circuit in connector  
of water temperature sensor.

Set value approx. 5 V

Is set value attained?



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L17

<=>

L18

<=>

# SELF-DIAGNOSIS TEST PROGRAM ( 3 )

Flashing code: "5"

Component: Test active bucking damping (ARD) for proper functioning.

Allow engine to idle.

Slowly increase engine speed to approx. 900 min<sup>-1</sup>. The engine must briefly misfire.

(ARD) functioning?

N>

1st test  
Test ARD servo magnet.

Detach plug connection at servo magnet of fuel-injection pump.

Apply battery voltage (only for brief period, approx. 3 sec., otherwise servo magnet defect). See top picture.

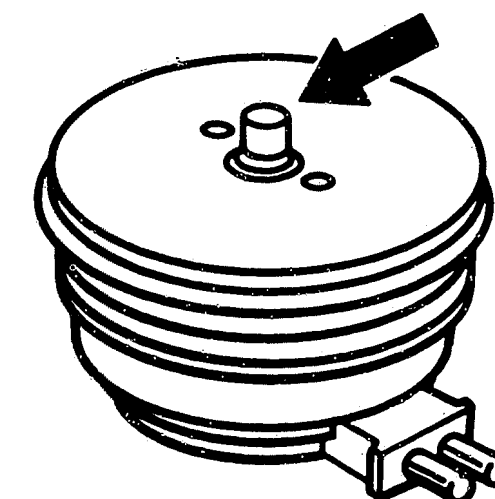
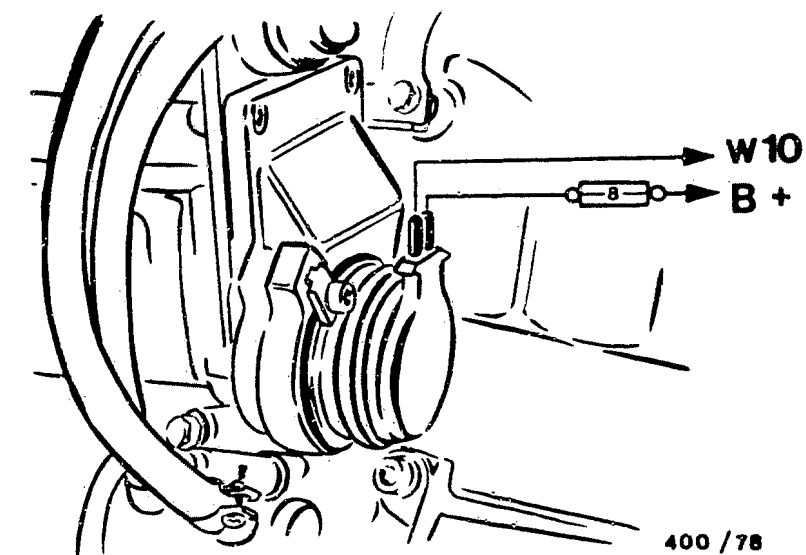
If idle speed does not decrease , renew ARD servo magnet.

When renewing servo magnet, existing shift pin (arrow) must be installed in new servo magnet.

This ensures that the clearance between spring retainer and lifter rod is maintained.

If idle speed decreases, test voltage at ARD plug. Allow engine to idle. Briefly acc. to full throttle. If there is no increase in voltage value, check fuse at over-voltage protection. Test leads in accordance with circuit diagram.

End of test.  
Active bucking damping O.K.



Continued on next picture page

# SELF-DIAGNOSIS TEST PROGRAM ( 4 )

Flashing code: "6"

Component: Test idle-speed regulation (ELR)  
Engine 603 only.

Engine idling.  
Regulated idle speed  
Set value:

Engine 603 912:  
610...650 min -1  
Engine 603 913:  
660...700 min -1

Detach plug at servo magnet  
for at least 3 seconds.

Upon re-connection, idle  
speed briefly exceeds the  
regulated idle speed.  
Does the idle speed increase ?

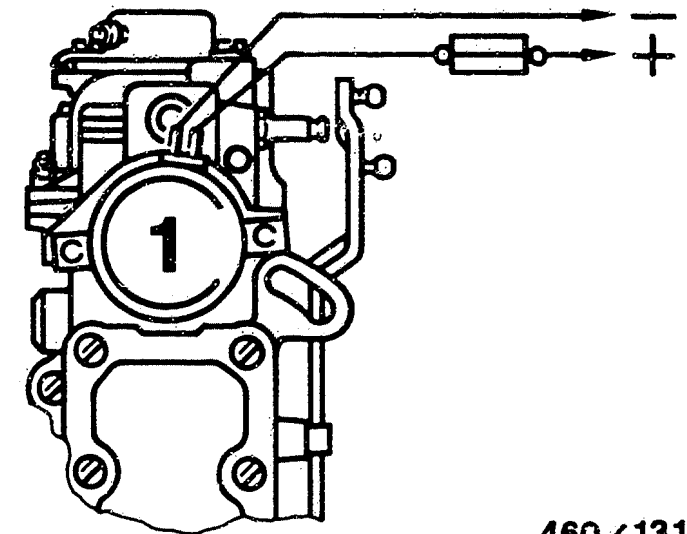
N>

## 1st test step

1. Detach plug at servo magnet;  
apply (see picture) 12 V for brief  
period (max. 3 seconds as otherwise  
servo magnet defective).  
If there is no increase in idle  
speed:  
Servo magnet defective - renew  
Pay attention to shims when removing  
and installing.

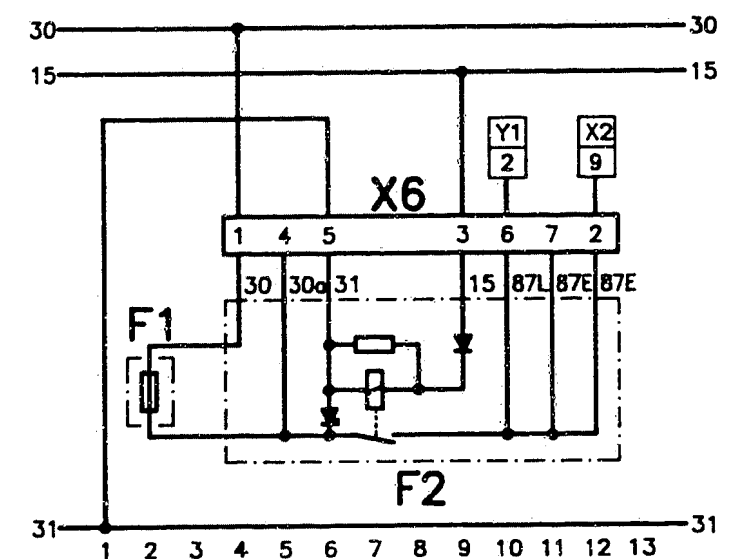
## 2nd test step

1. Engine switched off.  
Use voltmeter to establish whether  
approx. battery voltage is being  
applied at both contacts of fuse  
at over-voltage protection.  
Renew defective fuse.  
2. Test for open-circuit in lead  
of engine multiple butt connector  
term. 30, plug-connection lead,  
engine compartment socket 1 and  
battery ground lead with respect  
to over-voltage protection term. 1,  
5 and 3 in each case.  
3. Test for open-circuit in lead  
from over-voltage protection  
term. 6 to servo magnet.  
Eliminate open-circuit.



460 / 1312

X6 = Plug connection  
F1 = Central electrics console  
F2 = Over-voltage protection



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SELF-DIAGNOSIS TEST PROGRAM ( 4 ) (CONTINUED 1)

4. Detach ELR/ARD control unit.  
Test for open-circuit in  
leads from control-unit  
base term. 11 to battery ground,  
from term. 8 to coolant  
temperature sensor, from term. 10  
and 12 to engine-speed sensor  
and term. 9 to over-voltage  
protection term. 12.  
Eliminate open-circuit.

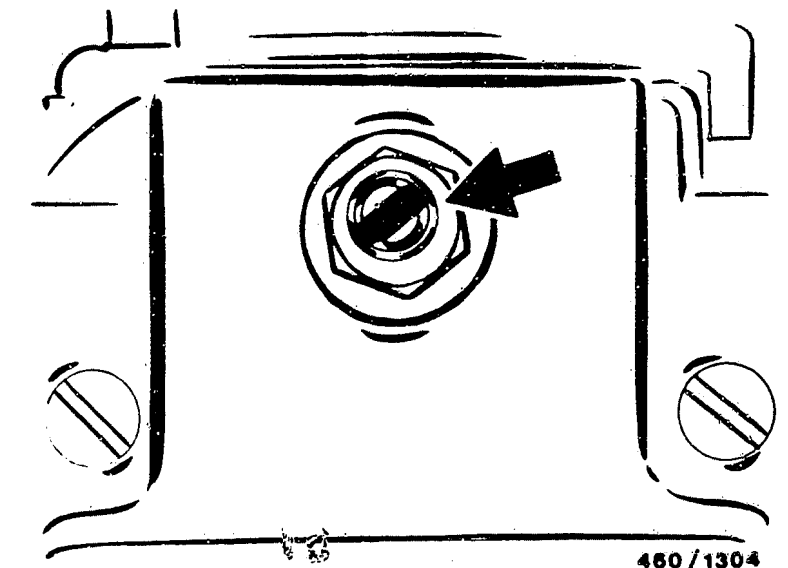
3rd TEST STEP  
Attach control unit.  
Engine idling.  
Detach plug from servo magnet  
and test voltage at plug.  
Set value for reading:  
approx. 12 volts  
If voltage not attained,  
renew ALR/ARD control unit

Test unregulated idle speed.  
Plug at servo magnet  
detached.  
Engine 603.912:  
530...610 min<sup>-1</sup>  
Engine 603.913:  
530...610 min<sup>-1</sup>

Idle speed O.K.

N>

Loosen lock nut and adjust idle  
speed at idle-speed adjusting screw  
(arrow)



460/1304

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# SELF-DIAGNOSIS TEST PROGRAM ( 4 ) (CONTINUED 2)

Test individual trimming plug  
-if applicable  
Installation pos.: Next to batt.

Engine switched off.  
Detach individual trimming  
plug from twin coupling.  
Glow-plug and starter switch  
in pos. "2", measure voltage.

Set value: approx. 5 volts

N>

Test for open-circuit in lead  
from individual trimming plug to  
ELR/ARD control unit term. 1  
and eliminate any open-circuits.

Renew individual trimming plug.  
3 different resistors can be  
fitted depending on the  
complaint. Test drive vehicle  
following modification.

## Part-load bucking

| Part No.     | Resistance   |
|--------------|--------------|
| 000 540 2981 | 100 $\Omega$ |
| 000 540 2281 | 220 $\Omega$ |
| 000 540 2381 | 470 $\Omega$ |

## Poor acceleration:

| Part No.     | Resistance    |
|--------------|---------------|
| 000 540 2581 | 1300 $\Omega$ |
| 000 540 2681 | 2400 $\Omega$ |
| 000 540 2781 | 4700 $\Omega$ |

## Note:

The ignition must be switched  
off when changing the indivi-  
dual trimming plug.  
Otherwise the new trimming  
is not detected.

Trouble-shooting instructions : MB-5047

BOSCH system : M-pump with RSF governor

Make of vehicle : MB

Basic microcard : MB-511

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Mercedes-Benz model

300 TD (Typ 124)  
9.87 ->

Engine: 603.912

Swiss version with EGR (exhaust-gas recirculation) system.

The fuel-injection system differs as follows from that of the 603.912 Std. engine:

- Altitude-pressure compensator (ADA)
- Exhaust-gas recirculation (pneumatic/electronic control).
- Glow-plug relay with after-glow and rod-type glow plugs.

USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

In line with the customer complaint, the trouble-shooting chart gives an indication of various possible causes/ component faults.

Detailed trouble-shooting information is given in the trouble-shooting chart in the basic instructions.

TEST SPECIFICATIONS

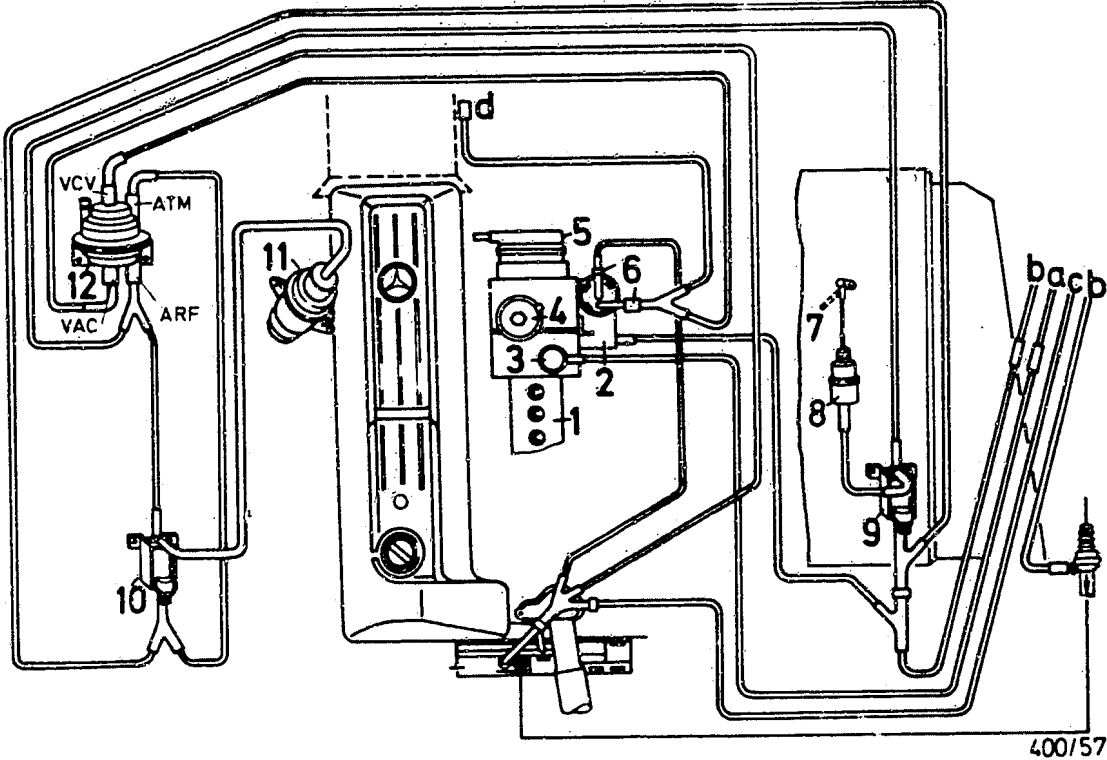
Idle speed:

| Engine  | Regulated | Unregulated |
|---------|-----------|-------------|
| 603.912 | 610...650 | 530...610   |

Vacuum control

- Vacuum values

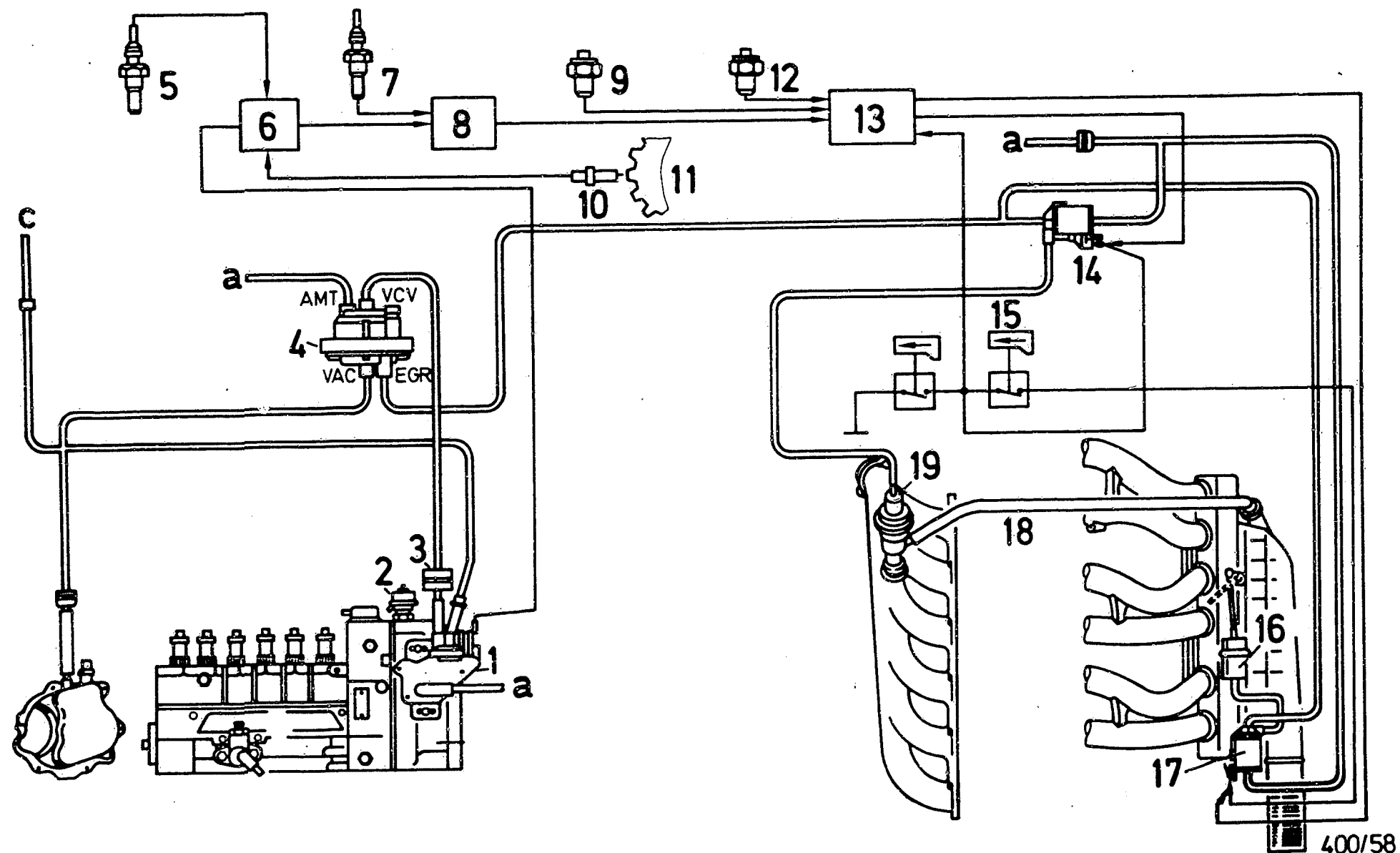
| min-1       | Pressure values | Pressure-control flap      |
|-------------|-----------------|----------------------------|
| 610...650   | 0               | Basic setting (open)       |
| 950...1050  | 150...360       | Full energization (closed) |
| 2450...2550 | 150...360       | Basic setting (open)       |
| 2950...3050 | 0               | Basic setting (open)       |



- 1 = Fuel-injection pump
- 2 = Vacuum control valve
- 3 = Vacuum-unit stop
- 4 = ADA unit
- 5 = Idle-speed-regulation servo magnet
- 6 = Throttle (blue)
- 7 = Pressure-control flap
- 8 = Vacuum unit/pressure-control flap
- 9 = Change-over valve, pressure-control flap
- 10 = Change-over valve, EGR
- 11 = EGR valve
- 12 = Pressure converter

- a = Passenger-compartment ventilation
- b = Key shutoff
- c = Load
- d = Automatic-transmission vacuum unit
- VCV = to vacuum control valve
- VAC = Vacuum supply
- ATM = Passenger-compartment ventilation
- ARF = to EGR valve

ROUTING OF VACUUM LINES Type 124  
-Engine 603.912 Swiss version



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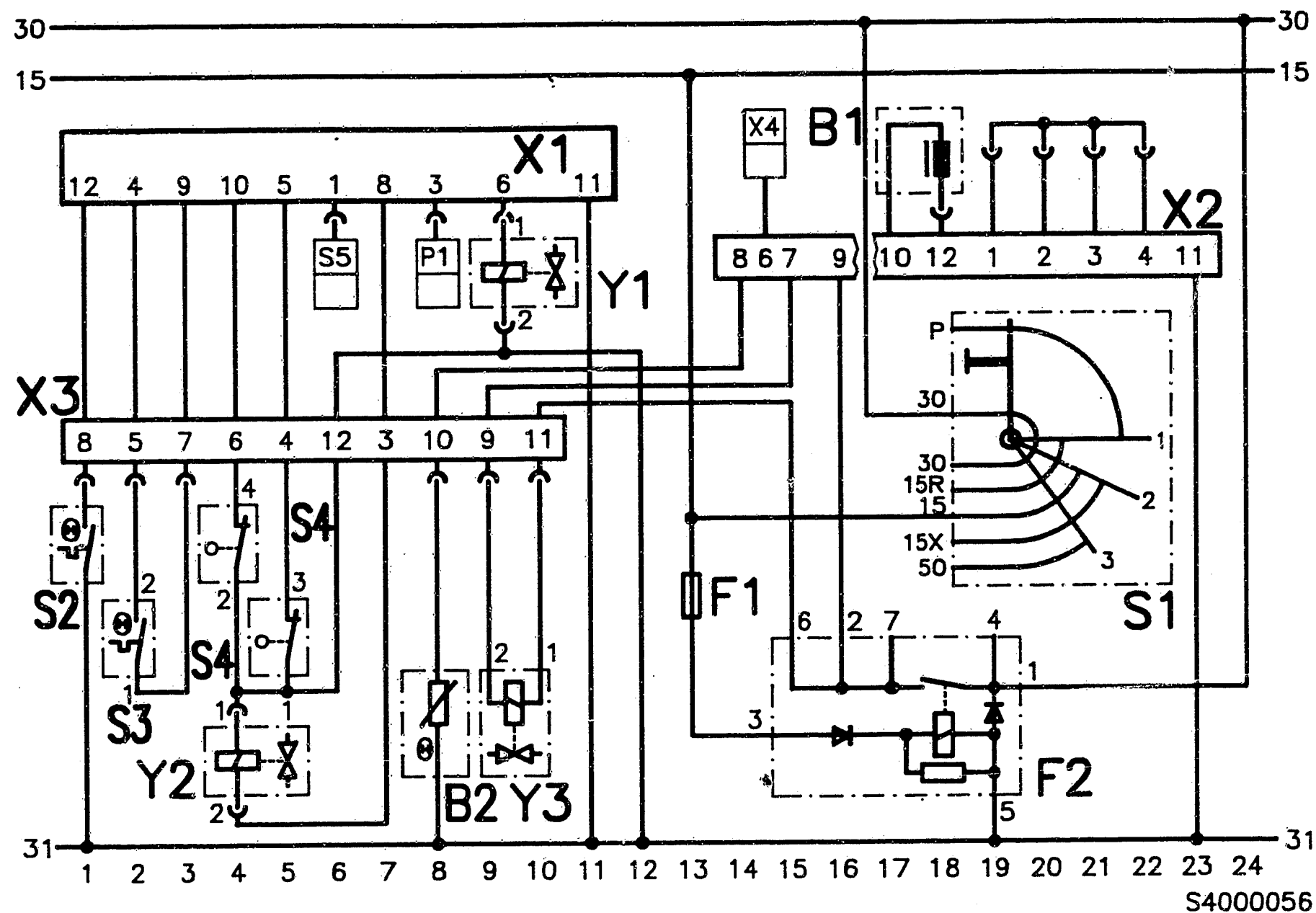
- 1 = Vacuum control valve
- 2 = ADA unit
- 3 = Damper
- 4 = Pressure transducer
- 5 = Coolant temperature sensor
- 6 = Idle-speed-regulation control unit
- 7 = Coolant temperature sensor
- 8 = Compressor-cutoff control unit
- 9 = Temperature switch 25°C EGR
- 10 = Engine-speed sensor, starting-motor ring gear
- 11 = Starting-motor ring gear

- 12 = Temperature switch 97°C EGR
- 13 = EGR control unit
- 14 = EGR change-over valve
- 15 = EGR microswitch
- 16 = Vacuum unit/pressure-control flap
- 17 = Change-over valve/pressure-control flap
- 18 = EGR line
- 19 = EGR valve

a = Passenger-compartment ventilation  
c = Other loads

SYSTEM OVERVIEW: PNEUMATIC / ELECTRONIC EXHAUST-GAS RECIRCULATION





- |                                   |                                                      |
|-----------------------------------|------------------------------------------------------|
| B1 = Engine-speed sensor          | S5 = Microswitch, refrigerant-compressor cutoff, EGR |
| B2 = Coolant temperature sensor   | X1 = EGR control unit                                |
| F1 = Central electrics console    | X2 = Idle-speed-regulation (ELR) control unit        |
| F2 = Over-voltage protection      | X3 = Plug connection                                 |
| P1 = Rev. counter                 | X4 = Test coupling                                   |
| S1 = Glow-plug and starter switch | Y1 = EGR change-over valve                           |
| S2 = Temperature switch 25° C     | Y2 = Change-over valve for pressure-control flap     |
| S3 = Temperature switch 97° C     | Y3 = Servo magnet                                    |
| S4 = EGR microswitch              |                                                      |

ELECTRICAL TERMINAL DIAGRAM, EXHAUST-GAS RECIRCULATION WITHOUT A/C

Customer complaint (fault symptoms)

- | Cause (component fault)     | Effect                     |
|-----------------------------|----------------------------|
| 1. Faulty fuel pump         | 1. Engine will not start   |
| 2. Faulty spark plug        | 2. Engine will not start   |
| 3. Faulty battery           | 3. Engine will not start   |
| 4. Faulty distributor       | 4. Engine will not start   |
| 5. Faulty timing belt       | 5. Engine will not start   |
| 6. Faulty water pump        | 6. Engine will not start   |
| 7. Faulty oil pump          | 7. Engine will not start   |
| 8. Faulty alternator        | 8. Engine will not start   |
| 9. Faulty starter motor     | 9. Engine will not start   |
| 10. Faulty ignition switch  | 10. Engine will not start  |
| 11. Faulty fuel filter      | 11. Engine will not start  |
| 12. Faulty air filter       | 12. Engine will not start  |
| 13. Faulty oil filter       | 13. Engine will not start  |
| 14. Faulty timing chain     | 14. Engine will not start  |
| 15. Faulty water pump       | 15. Engine will not start  |
| 16. Faulty oil pump         | 16. Engine will not start  |
| 17. Faulty alternator       | 17. Engine will not start  |
| 18. Faulty starter motor    | 18. Engine will not start  |
| 19. Faulty ignition switch  | 19. Engine will not start  |
| 20. Faulty fuel filter      | 20. Engine will not start  |
| 21. Faulty air filter       | 21. Engine will not start  |
| 22. Faulty oil filter       | 22. Engine will not start  |
| 23. Faulty timing chain     | 23. Engine will not start  |
| 24. Faulty water pump       | 24. Engine will not start  |
| 25. Faulty oil pump         | 25. Engine will not start  |
| 26. Faulty alternator       | 26. Engine will not start  |
| 27. Faulty starter motor    | 27. Engine will not start  |
| 28. Faulty ignition switch  | 28. Engine will not start  |
| 29. Faulty fuel filter      | 29. Engine will not start  |
| 30. Faulty air filter       | 30. Engine will not start  |
| 31. Faulty oil filter       | 31. Engine will not start  |
| 32. Faulty timing chain     | 32. Engine will not start  |
| 33. Faulty water pump       | 33. Engine will not start  |
| 34. Faulty oil pump         | 34. Engine will not start  |
| 35. Faulty alternator       | 35. Engine will not start  |
| 36. Faulty starter motor    | 36. Engine will not start  |
| 37. Faulty ignition switch  | 37. Engine will not start  |
| 38. Faulty fuel filter      | 38. Engine will not start  |
| 39. Faulty air filter       | 39. Engine will not start  |
| 40. Faulty oil filter       | 40. Engine will not start  |
| 41. Faulty timing chain     | 41. Engine will not start  |
| 42. Faulty water pump       | 42. Engine will not start  |
| 43. Faulty oil pump         | 43. Engine will not start  |
| 44. Faulty alternator       | 44. Engine will not start  |
| 45. Faulty starter motor    | 45. Engine will not start  |
| 46. Faulty ignition switch  | 46. Engine will not start  |
| 47. Faulty fuel filter      | 47. Engine will not start  |
| 48. Faulty air filter       | 48. Engine will not start  |
| 49. Faulty oil filter       | 49. Engine will not start  |
| 50. Faulty timing chain     | 50. Engine will not start  |
| 51. Faulty water pump       | 51. Engine will not start  |
| 52. Faulty oil pump         | 52. Engine will not start  |
| 53. Faulty alternator       | 53. Engine will not start  |
| 54. Faulty starter motor    | 54. Engine will not start  |
| 55. Faulty ignition switch  | 55. Engine will not start  |
| 56. Faulty fuel filter      | 56. Engine will not start  |
| 57. Faulty air filter       | 57. Engine will not start  |
| 58. Faulty oil filter       | 58. Engine will not start  |
| 59. Faulty timing chain     | 59. Engine will not start  |
| 60. Faulty water pump       | 60. Engine will not start  |
| 61. Faulty oil pump         | 61. Engine will not start  |
| 62. Faulty alternator       | 62. Engine will not start  |
| 63. Faulty starter motor    | 63. Engine will not start  |
| 64. Faulty ignition switch  | 64. Engine will not start  |
| 65. Faulty fuel filter      | 65. Engine will not start  |
| 66. Faulty air filter       | 66. Engine will not start  |
| 67. Faulty oil filter       | 67. Engine will not start  |
| 68. Faulty timing chain     | 68. Engine will not start  |
| 69. Faulty water pump       | 69. Engine will not start  |
| 70. Faulty oil pump         | 70. Engine will not start  |
| 71. Faulty alternator       | 71. Engine will not start  |
| 72. Faulty starter motor    | 72. Engine will not start  |
| 73. Faulty ignition switch  | 73. Engine will not start  |
| 74. Faulty fuel filter      | 74. Engine will not start  |
| 75. Faulty air filter       | 75. Engine will not start  |
| 76. Faulty oil filter       | 76. Engine will not start  |
| 77. Faulty timing chain     | 77. Engine will not start  |
| 78. Faulty water pump       | 78. Engine will not start  |
| 79. Faulty oil pump         | 79. Engine will not start  |
| 80. Faulty alternator       | 80. Engine will not start  |
| 81. Faulty starter motor    | 81. Engine will not start  |
| 82. Faulty ignition switch  | 82. Engine will not start  |
| 83. Faulty fuel filter      | 83. Engine will not start  |
| 84. Faulty air filter       | 84. Engine will not start  |
| 85. Faulty oil filter       | 85. Engine will not start  |
| 86. Faulty timing chain     | 86. Engine will not start  |
| 87. Faulty water pump       | 87. Engine will not start  |
| 88. Faulty oil pump         | 88. Engine will not start  |
| 89. Faulty alternator       | 89. Engine will not start  |
| 90. Faulty starter motor    | 90. Engine will not start  |
| 91. Faulty ignition switch  | 91. Engine will not start  |
| 92. Faulty fuel filter      | 92. Engine will not start  |
| 93. Faulty air filter       | 93. Engine will not start  |
| 94. Faulty oil filter       | 94. Engine will not start  |
| 95. Faulty timing chain     | 95. Engine will not start  |
| 96. Faulty water pump       | 96. Engine will not start  |
| 97. Faulty oil pump         | 97. Engine will not start  |
| 98. Faulty alternator       | 98. Engine will not start  |
| 99. Faulty starter motor    | 99. Engine will not start  |
| 100. Faulty ignition switch | 100. Engine will not start |

|     |   |     |
|-----|---|-----|
| M09 | — | ==> |
|-----|---|-----|

Customer complaint (fault symptoms)

- Cause (component fault)**

|     |  |     |
|-----|--|-----|
| M10 |  | <== |
|-----|--|-----|

## EXHAUST-GAS RECIRCULATION

### Test conditions:

Exhaust-gas recirculation is effected if the following items are satisfied:

-Engine speed between  
950...1050 min<sup>-1</sup>  
and 2900...3000 min<sup>-1</sup>

-Coolant temperature between 25 °C  
and 97 °C

-Pressure-control flap closed between  
950...1050 min<sup>-1</sup>  
and 2450...2550 min<sup>-1</sup>

-Accelerator pedal not in full-throttle position, since  
EGR valve is closed shortly prior to full throttle by way  
of microswitch.

For production reasons:  
continued on the following  
coordinate.

## TEST EXHAUST-GAS RECIRCULATION ( 1 )

Test EGR valve with engine off:

Apply approx. 300 mbar vacuum to exhaust-gas recirculation valve.  
Detach vacuum line.

Can EGR valve be heard to close?

Renew EGR valve.

N>

Test pressure converter and pressure setting:  
Installation location: bulkhead

Connect vacuum tester with Y-type distributor to EGR connection (exhaust-gas recirculation valve) and read off vacuum value at idle speed.

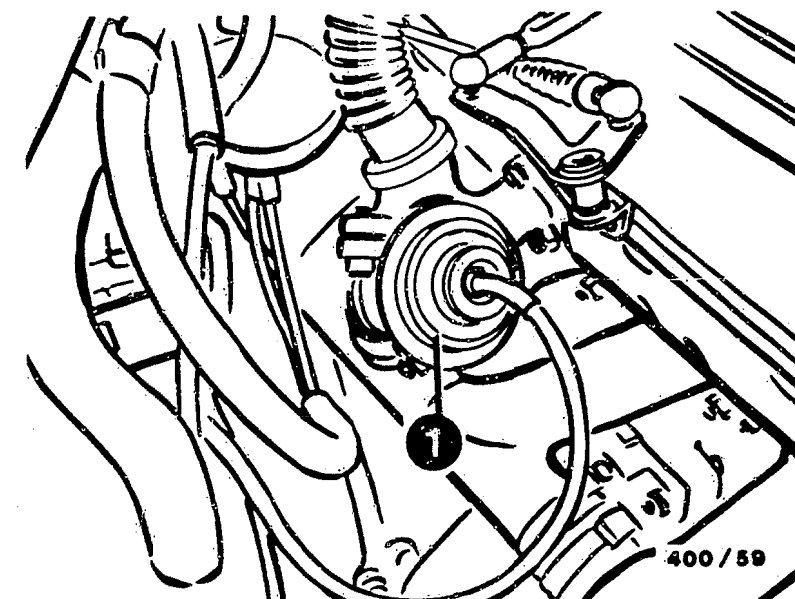
Set value: 330...370 mbar  
Vacuum O.K.

Test supply pressure at connection "C" (change-over valve).  
Test vacuum supply at vacuum pump.

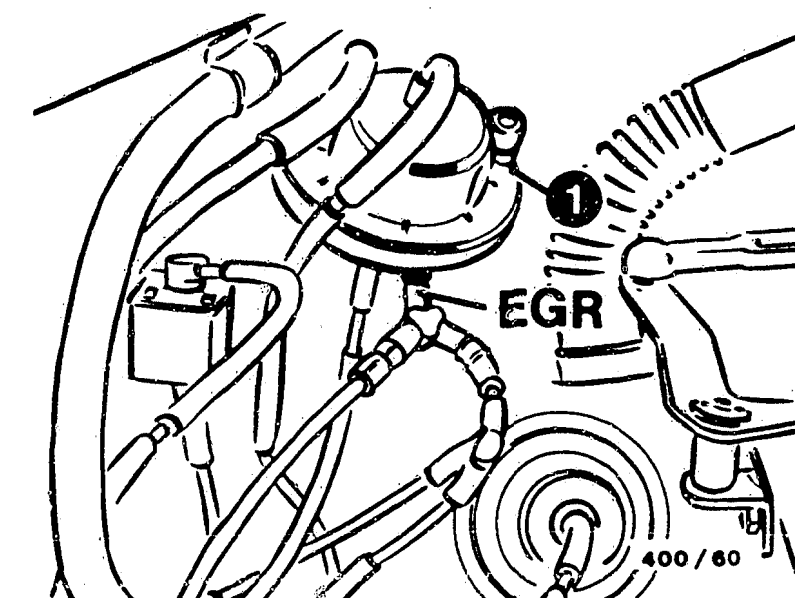
Set value: > 700 mbar.

N>

Continued on next picture page



1 = EGR valve



1 = Pressure converter

## TEST EXHAUST-GAS RECIRCULATION ( 2 )

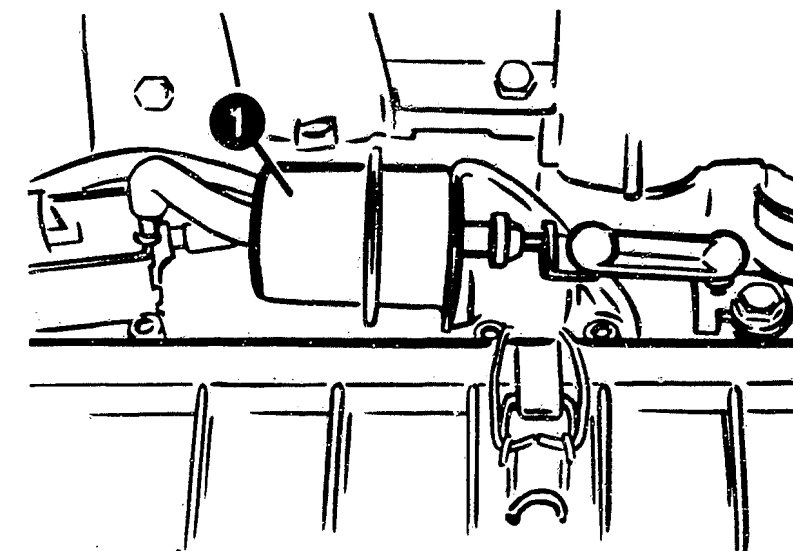
### Test vacuum control:

Connect vacuum tester with Y-type distributor to EGR valve.  
Read off vacuum values and position of vacuum unit/pressure-control flap at following engine speeds.

Set values: see test-specification section.  
Set values within tolerance.

N>

Test pressure supply and individual components.



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1 = Vacuum unit

### Test microswitch.

Connect vacuum tester with Y-type distributor to EGR valve.  
Run engine at  $1000 \pm 50 \text{ min}^{-1}$ .  
Actuate microswitch 1.  
Pressure at EGR valve drops to 0 mbar.  
Pressure-control flap moves to basic setting (open).

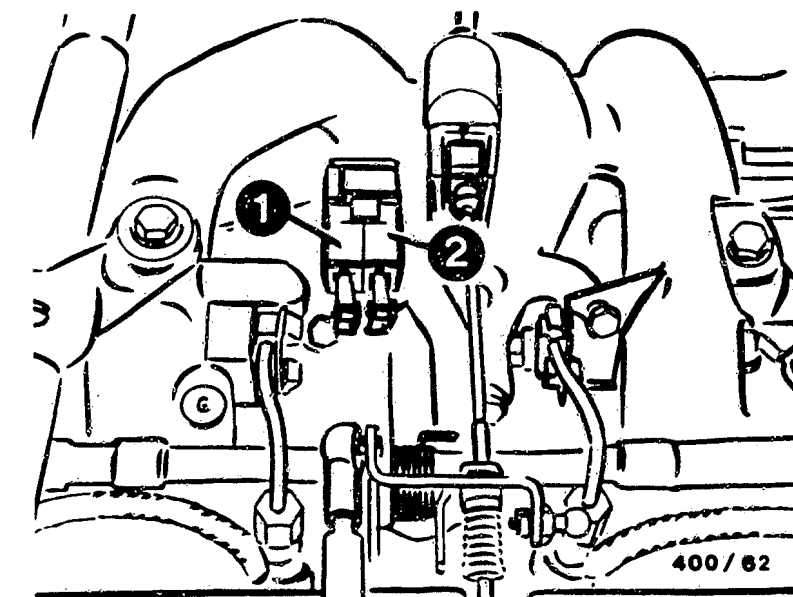
Actuate microswitch 2, pressure-control flap moves to basic setting.

Function O.K.

N>

Test individual components.

1 = Microswitch  
2 = Microswitch



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Continued on next picture page

## TEST EXHAUST-GAS RECIRCULATION ( 3 )

### Test individual components

#### Test vacuum control valve:

Connect vacuum tester to connection "VCV" of pressure converter and test vacuum at idle speed.

Set values:  
610..650 min  $-1$  / 360..410 mbar

Engine switched off and regulating linkage on full-load stop.

Set value: 0 mbar  
Are test specifications attained

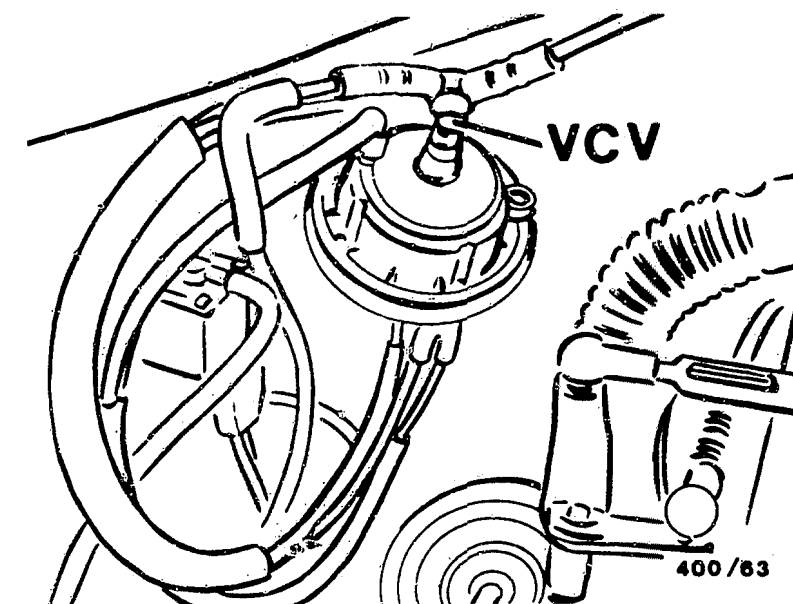
N>

#### Test vacuum lines for leaks:

Test supply pressure at vacuum pump.

Set value:  $> 700$  mbar

Adjust vacuum control valve:  
Shift regulating lever of fuel-injection pump to full load.  
Turn vacuum control valve as far as it will go in a clockwise direction (slot), arrow.  
Tighten fastening screws in this position.



### Test change-over valves:

Connect voltmeter to plug connection of change-over valves.  
Run engine at 1150...1250 min  $-1$  .

Set value: 12 V

Set value attained

N>

Test electrical actuation in accordance with diagram.  
Renew EGR control unit.

Continued on next picture page

# TEST EXHAUST-GAS RECIRCULATION ( 4 )

Connect vacuum tester with Y-type distributor to connection "C", change-over valve.  
Run engine at 950..1050 min<sup>-1</sup>.  
Read off vacuum value.

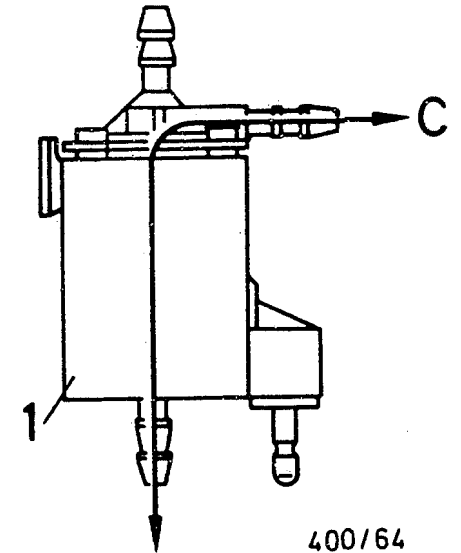
Set value: 290...310 mbar  
(measured at both change-over valves).

Vacuum value O.K.

Test vacuum lines for leaks.

Test vacuum supply at vacuum pump.

Set value: > 700 mbar



1 = Change-over valve

Flashing code "2"  
Component: Engine-speed sensor  
In engine compartment next to battery

Test 1: Ground connection

Detach multiple butt connector from engine-speed sensor.  
Connect ohmmeter with commercially available test prods to one wiring post in each case and ground.

Set value: > 1 M  $\Omega$

Set value attained?

Engine-speed sensor defective,  
renew.

Continued on next picture page

# TEST EXHAUST-GAS RECIRCULATION ( 5 )

## Test 2: Engine-speed signal

Connect multimeter to test coupling for engine-speed signal.  
Allow engine to idle.

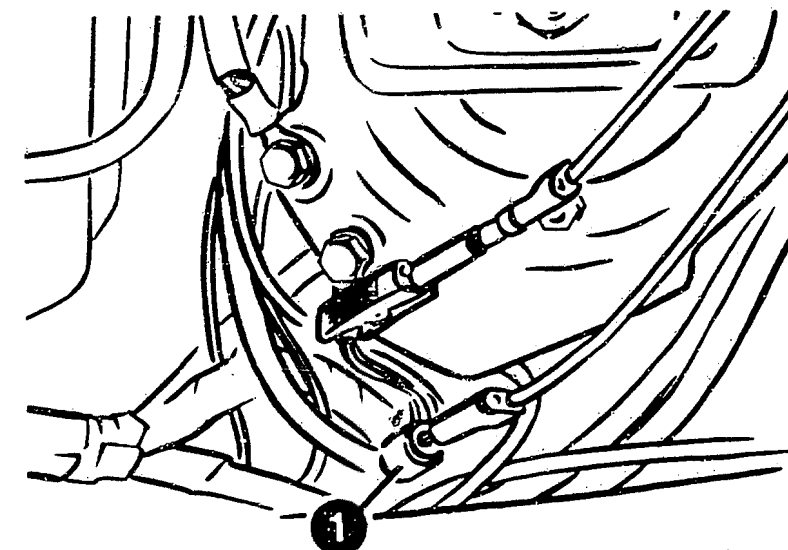
Set value: > 2.8 V AC

N>

Detach multiple butt connector from engine-speed sensor.  
Connect ohmmeter with test leads to both wiring posts.

Set value: 1.7...2.1 K  $\Omega$

Set value outside tolerance  
Renew engine-speed sensor.



400/63

1 = Test coupling  
Engine-speed signal

Check to see whether engine-speed sensor is dirty:

N>

Detach multiple butt connector from engine-speed sensor.  
Connect test lead.  
Allow engine to idle.

Test value: > 4 V

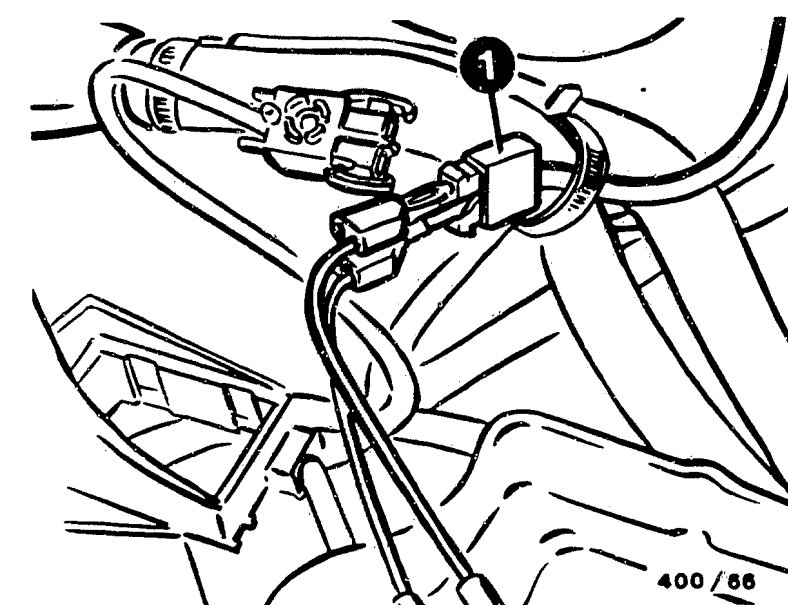
Note:  
Voltage increases with increasing engine speed.

Check to see whether engine-speed sensor is dirty.

Test for open-circuit in leads.

Renew EGR control unit.

1 = Multiple butt connector  
Engine-speed sensor



400/66

Continued on next picture page



# TEST EXHAUST-GAS RECIRCULATION ( 6 )

Test idle contact at microswitch.  
Top picture

N>

Renew microswitch.

Engine switched off.  
Detach coupling at microswitch.  
Connect ohmmeter with test lead to  
term. 2 and 4 and test for con-  
tinuity.

At idle: 0  $\Omega$   
With full throttle: infinity

Set value attained

Test full-load contact at micro-  
switch:  
Bottom picture

N>

Renew microswitch.

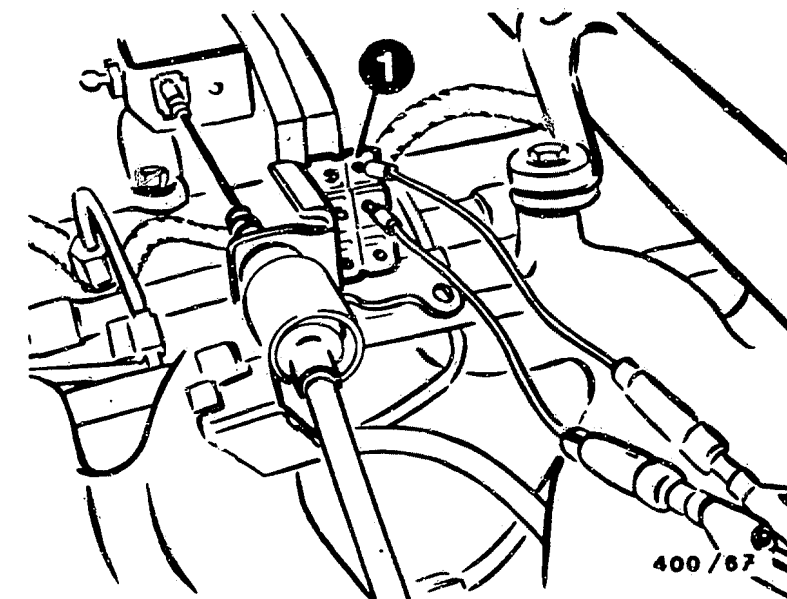
Engine switched off.  
Coupling detached at microswitch.

Connect ohmmeter with test lead to  
term. 1 and 3 and test for con-  
tinuity.

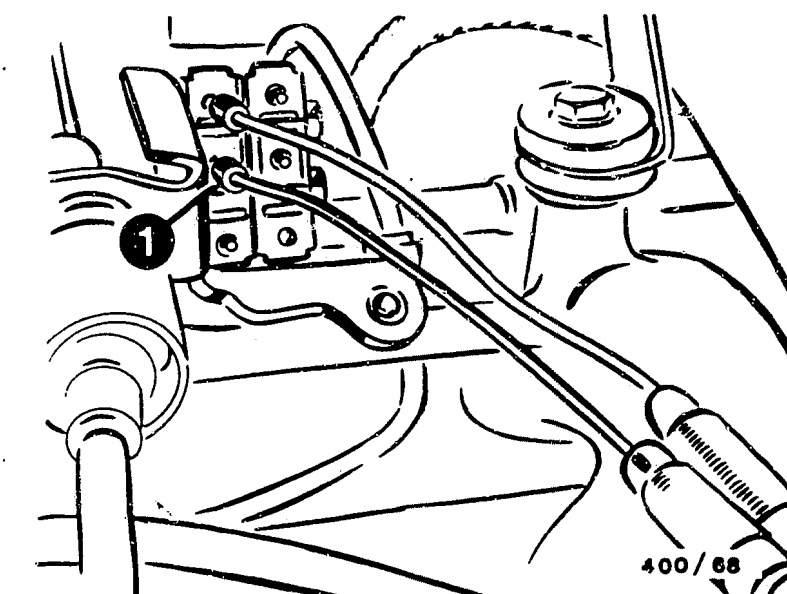
At idle: infinity  
With full throttle: 0  $\Omega$

Reading O.K.

Continued on next picture page



1 = Microswitch  
Idle contact



1 = Microswitch  
Full-load contact

## TEST EXHAUST-GAS RECIRCULATION ( 7 )

Test temperature switch 25°C:

Connect vacuum tester to EGR valve.

Engine temperature > 25°C  
Run engine at 1000 min<sup>-1</sup>.

Detach connector from temperature switch and ground it.

Set value: 0 mbar

Function O.K.

Test electrical actuation.

Test temperature switch 97°C:

Connect vacuum tester to EGR valve.

Run engine at 1200 min<sup>-1</sup>.  
Detach connector from temperature switch and ground it.

Set value: 0 mbar

Function O.K.

Test electrical actuation.

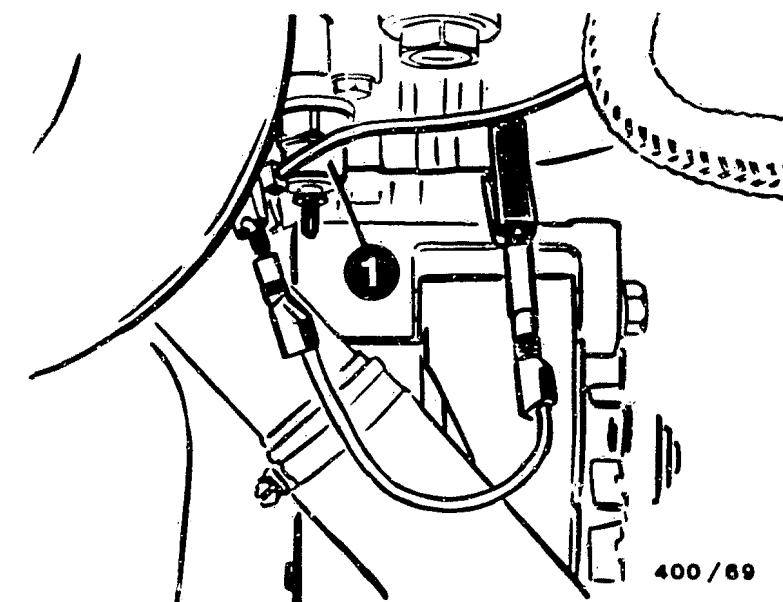
Return to trouble-shooting chart  
09

M25

⟷

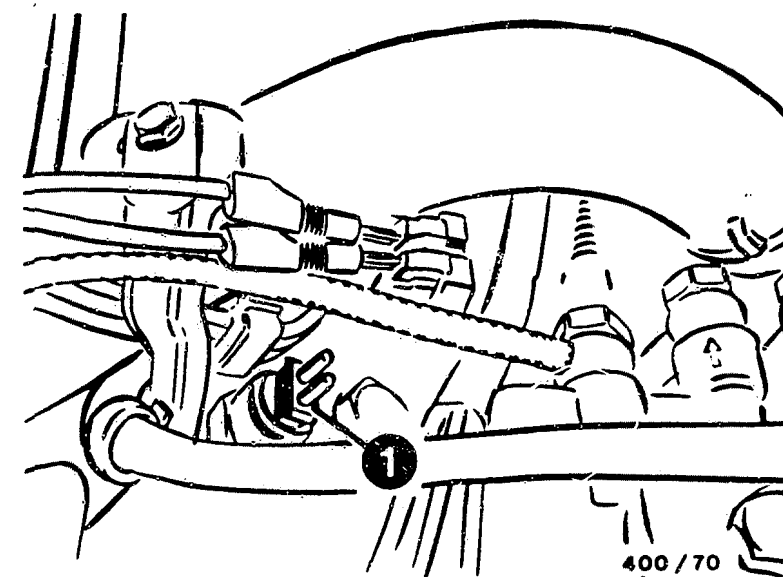
M26

⟷



1 = Temperature switch 25° C

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1 = Temperature switch 97° C

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# TEST IN PREHEATING SYSTEM 1

## Test glow plug system

Fault is indicated by glow-plug indicator lamp.

Does glow-plug indicator lamp light up during preheating.

N>

Glow-plug indicator lamp defective.  
Test for open-circuit in lead from indicator lamp to glow-time control relay.  
Eliminate open-circuit.  
Glow-time control relay defective.

Does indicator lamp fail to light up when driving?

N>

One or more glow plugs defective.

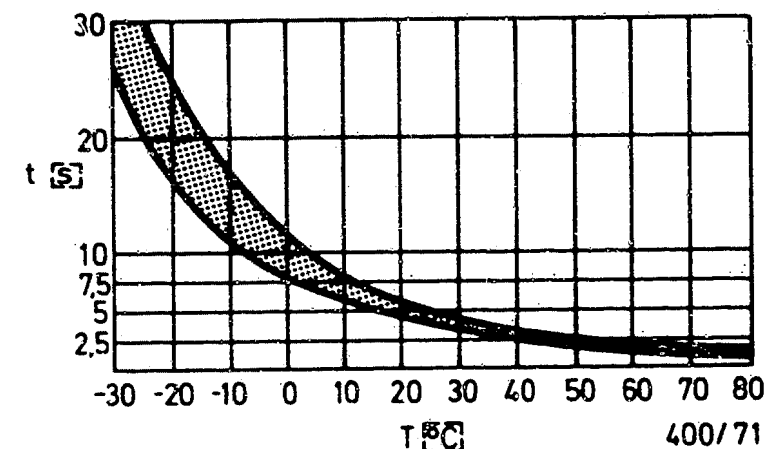
## Test preheating time:

Note: The preheating time is a function of the coolant temperature.  
Does glow-plug indicator lamp go out following completion of preheating time.  
See picture

N>

Glow-time control relay defective.

Return to trouble-shooting chart 09



Trouble-shooting instructions : MB - 5046

BOSCH system : M-pump with RSF governor

Make of vehicle : MB

Basic microcard : MB-511

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following Mercedes-Benz models.

- 190 D 2.5 Turbo (Type 201.128)
- 250 D Turbo (Type 201.128)
- 300 D Turbo (Type 124.133)
- 300 D Turbo (Type 124.333) 4Matic
- 9.87 ->

Engine: 602.961-USA with flashing-code diagnosis  
Idle-speed regulation (ELR)  
603.960-USA without flashing-code diagnosis\*  
603.963-ECE without flashing-code diagnosis\*  
with automatic transmission

\* Note:

The 603 engine is to be provided at a later date with the control unit for flashing-code diagnosis. The individual components of the idle-speed regulation system are to be tested in accordance with the flashing-code evaluation sequence.

The fuel-injection system differs as follows from that of the 603.912 engine.

- Absolute metering manifold-pressure compensator (ALDA).
- Exhaust turbo-supercharger

USAGE

These brief instructions essentially comprise vehicle-specific special features and test specifications (set values).

In line with the customer complaint, the trouble-shooting chart gives an indication of various possible causes/component faults.

Detailed trouble-shooting information is given in the trouble-shooting chart in the basic instructions.

TEST SPECIFICATIONS

Idle speed:

| Engine  | Regulated<br>min <sup>-1</sup> | Unregulated<br>min <sup>-1</sup> |
|---------|--------------------------------|----------------------------------|
| 602.961 | 660...700                      | 580...660                        |
| 603.960 | 610...650                      | 530...610                        |
| 603.963 | 660...700                      | 530...610                        |

Test vacuum control valve:

Set value:

Engine 602: 395...445 mbar  
Engine 603: 360...410 mbar

Test charge-air pressure under load:

at n = 4000 min <sup>-1</sup> 0.75...0.95 mbar

Adjust mechanical features of speed regulation:

Engine: 602.961

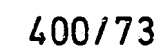
Tempomat connecting rod 247...263 mm  
Automatic-transmission idle-motion rod 189...205 mm  
Fuel-injection-pump connecting rod 211...227 mm

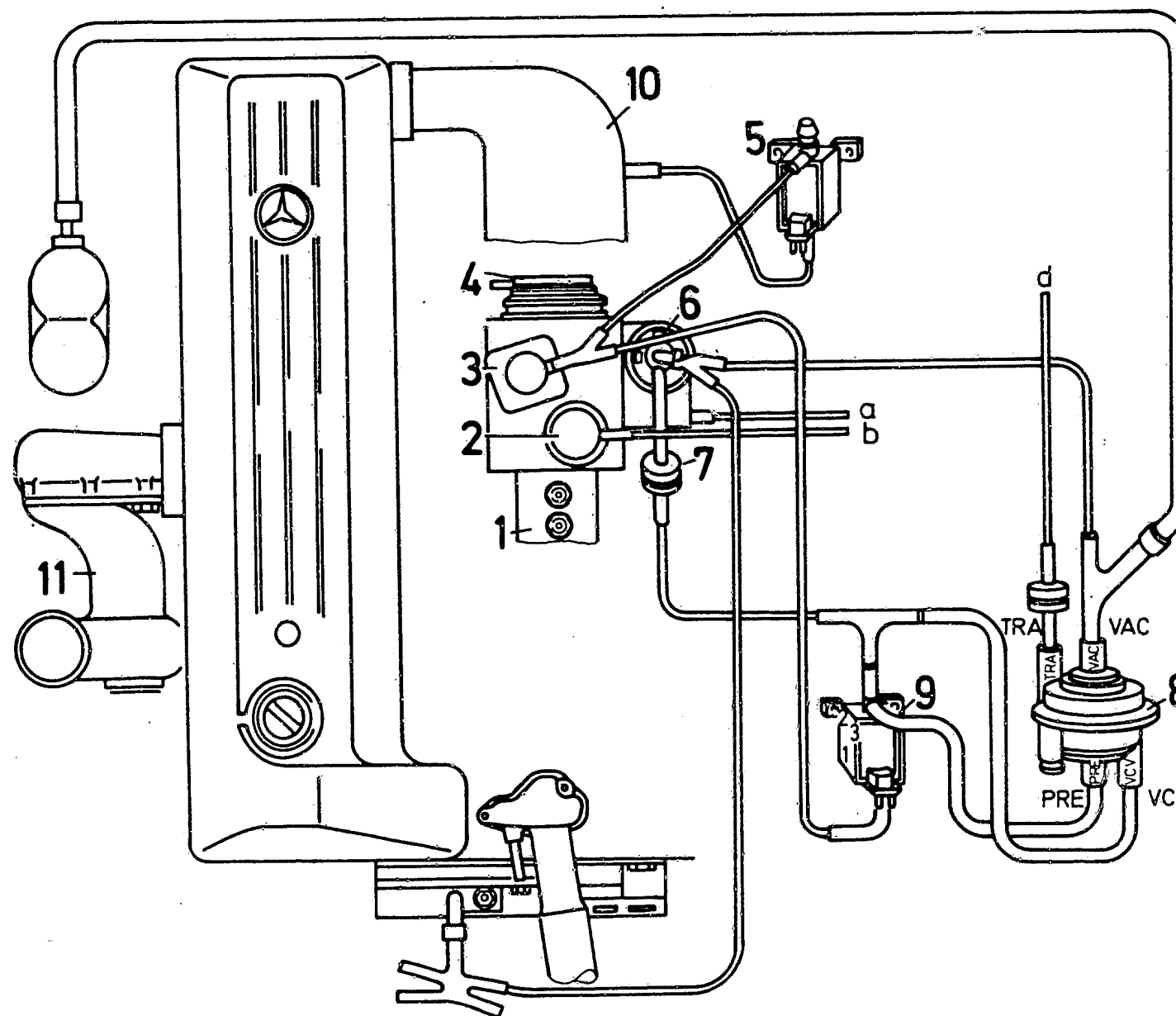
Engine: 603.96.

Tempomat connecting rod 93...109 mm  
Axial-shaft connecting rod 112...128 mm  
Fuel-injection-pump connecting rod 146...162 mm

TESTERS AND TOOLS

| Name                                              | Designation | Part no.      |
|---------------------------------------------------|-------------|---------------|
| Evaluation unit<br>for flashing-code<br>diagnosis |             | KDAW 9980     |
| Ohmmeter                                          | ETE 014.00  | 0 684 101 400 |
| Voltmeter                                         | ETE 014.00  | 0 684 101 400 |





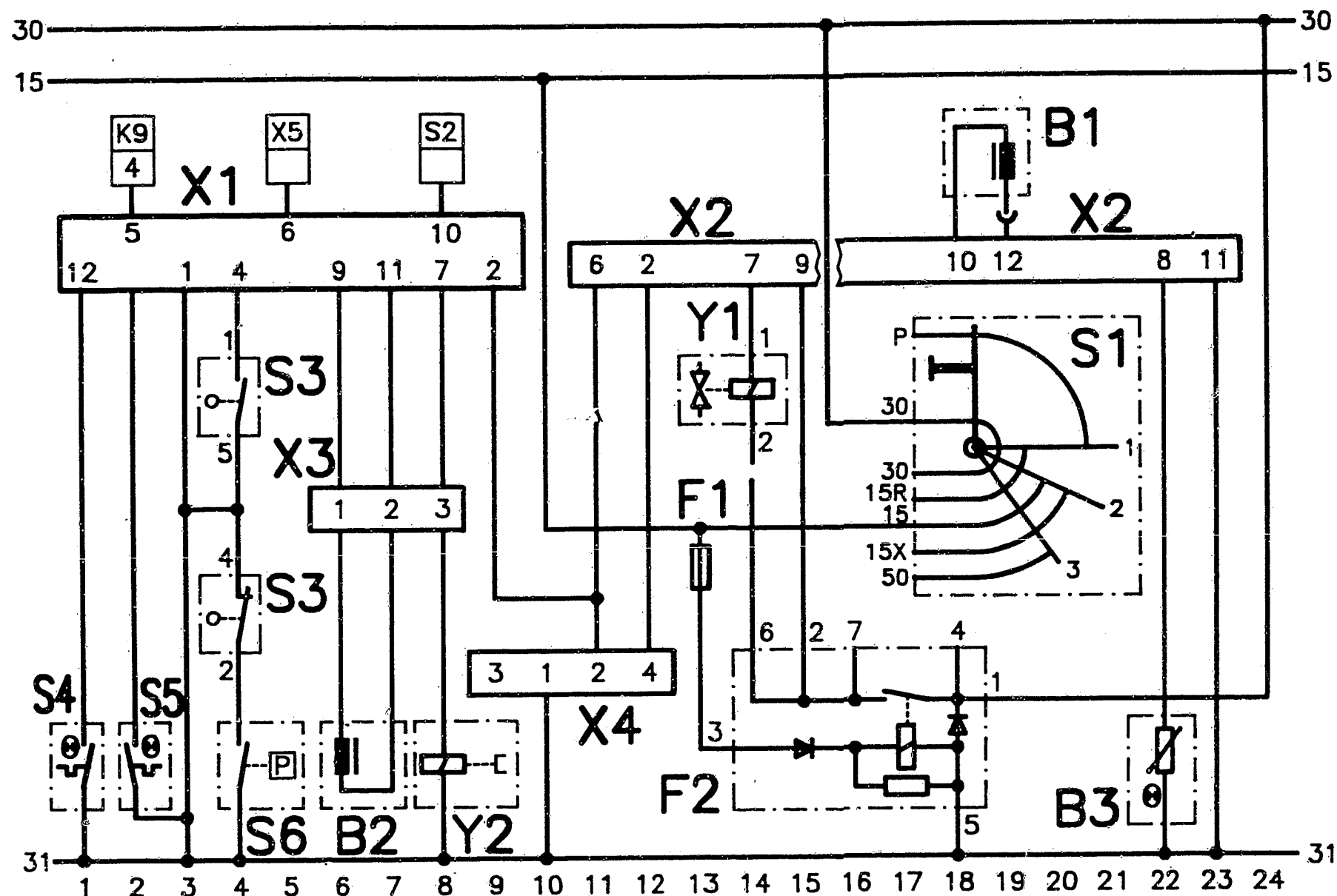
400174

- 1 = Fuel-injection pump
- 2 = Vacuum unit - stop
- 3 = ALDA unit
- 4 = Idle-speed-regulation servo magnet
- 5 = Change-over valve, engine overload protection
- 6 = Vacuum control valve
- 7 = Damper
- 8 = Pressure converter
- 9 = Change-over valve, pressure converter
- 10 = Charge distributor
- 11 = Turbocharger

- a = Passenger-compartment ventilation
- b = Key shutoff
- d = to vacuum unit, automatic transmission

- PRE = Charge-air pressure
- TRA = Transmission
- VAC = Vacuum supply
- VCV = to vacuum control valve

VACUUM-LINE DIAGRAMS Routing of vacuum lines Type 124



S4000072

- |       |                                                 |    |                                               |
|-------|-------------------------------------------------|----|-----------------------------------------------|
| B1    | = Engine-speed sensor, starting-motor ring gear | S4 | = Temperature switch 105/115°C                |
| B2/Y2 | = Refrigerant compressor                        | S5 | = Temperature switch 105/115°C                |
| B3    | = Coolant temperature sensor                    | S6 | = Engine-overload-protection switch           |
| F1    | = Central electrics console                     | X1 | = Control unit, refrigerant-compressor cutoff |
| F2    | = Over-voltage protection                       | X2 | = Control unit, idle-speed regulation (ELR)   |
| S1    | = Glow-plug and starter switch                  | X3 | = Plug connection                             |
| S2    | = Pressure switch, refrigerant compressor       | X4 | = Test coupling for flashing-code diagnosis   |
| S3    | = Charge-air-pressure switch                    | X5 | = Plug connection, lamp cable set             |
|       | -compressor cutoff                              | Y1 | = Servo magnet, fuel-injection pump           |

ELECTRICAL TERMINAL DIAGRAM TYPE 201 ENGINE 602.961 WITH AUTOMATIC AIR CONDITIONER



## TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Diagnosis lamp flashes (activation with KDAW 9980)
2. Starting motor operates, engine fails to start or starts only with difficulty (warm and cold)
3. Engine hunts when idling
4. Idle not smooth with warm engine
5. Idle speed too high/too low
6. Engine missing when driving
7. Inadequate engine power
8. Engine bucks at full load
9. Fuel consumption too high
10. Engine doesn't switch off or not immediately
11. Hard engine running

| Cause (component fault) |   |   |   |   |   |   |   |   |   |                                           |
|-------------------------|---|---|---|---|---|---|---|---|---|-------------------------------------------|
| *                       |   |   |   |   |   |   |   |   |   | Self-diagnosis                            |
| *                       |   |   | * | * |   |   |   |   |   | Tank ventilation                          |
| *                       | * | * | * | * |   |   | * |   |   | Injection sequence                        |
| *                       |   |   | * |   |   |   |   |   |   | Paraffin separation                       |
| *                       | * | * | * | * |   |   |   |   |   | Air in fuel system                        |
| *                       |   |   | * | * | * |   |   |   | * | Fuel lines leaking/clogged                |
| *                       | * | * | * | * |   |   |   |   |   | Supply lines clogged                      |
| *                       | * | * | * |   |   |   |   |   | * | Fuel-injection tubing clogged/constricted |
|                         | * | * | * | * |   |   |   |   | * | Engine air filter                         |
|                         | * | * | * |   |   |   |   |   |   | Idle speed, mechanical                    |
| *                       |   | * |   |   |   |   |   |   |   | Test idle-speed regulation (ELR)          |
|                         |   |   | * |   |   |   |   |   |   | Test active bucking damping (ARD)         |
|                         | * | * |   |   |   |   |   |   |   | Mechanical features of speed regulation   |
|                         |   |   |   |   |   |   |   | * |   | Vacuum system                             |
|                         |   |   |   |   |   |   | * | * |   | Injection nozzles                         |
| *                       |   |   | * | * | * |   |   |   |   | Fuel filter/overflow restriction          |
| *                       |   |   | * | * | * |   |   |   |   | Supply pump                               |
| *                       |   |   |   |   |   |   |   |   |   | Glow plug system                          |
|                         |   |   |   | * |   |   |   |   |   | Timing device                             |
|                         |   |   | * |   |   |   |   |   |   | Engine compression                        |
|                         |   |   | * | * | * |   |   |   |   | Pump/engine assignment                    |
| *                       | * | * | * | * | * | * | * | * | * | Fuel-injection pump                       |

## TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

12. Black smoke in full-load range
13. Cloud of smoke in full-load range
14. Engine won't rev up when cold
15. Part-load bucking
16. Poor acceleration
17. Fuel-injection pump

| Cause (component fault) |   |   |   |   |   |   |   |   |   |                                           |
|-------------------------|---|---|---|---|---|---|---|---|---|-------------------------------------------|
|                         |   |   |   |   |   |   |   |   |   | Self-diagnosis                            |
|                         | * |   |   |   |   |   |   |   |   | Tank ventilation                          |
| *                       | * |   |   |   |   |   |   |   |   | Injection sequence                        |
|                         |   |   |   | * |   |   |   |   |   | Paraffin separation                       |
|                         | * |   |   |   |   |   |   |   |   | Air in fuel system                        |
|                         | * |   |   |   |   |   |   |   |   | Fuel lines leaking/clogged                |
|                         | * |   | * |   |   |   |   |   | * | Supply lines clogged                      |
| *                       |   |   |   |   |   |   |   |   |   | Fuel-injection tubing clogged/constricted |
| *                       |   |   |   |   |   |   |   |   |   | Engine air filter                         |
|                         |   |   |   |   |   |   |   |   |   | Idle speed, mechanical                    |
|                         |   |   |   |   |   |   |   |   |   | Test idle-speed regulation (ELR)          |
|                         |   | * | * |   |   |   |   |   |   | Test active bucking damping (ARD)         |
|                         |   |   |   |   |   |   |   |   |   | Mechanical features of speed regulation   |
|                         |   |   |   |   |   |   |   |   |   | Vacuum system                             |
| *                       | * |   |   |   |   | * |   |   |   | Injection nozzles                         |
|                         |   |   |   |   |   |   |   |   |   | Fuel filter/overflow restriction          |
|                         |   |   |   |   |   |   |   |   |   | Supply pump                               |
|                         |   |   |   |   |   |   |   |   |   | Glow plug system                          |
|                         |   |   |   |   |   |   |   |   |   | Timing device                             |
| *                       | * |   |   |   |   |   |   |   |   | Engine compression                        |
| *                       | * |   |   |   |   |   |   |   |   | Pump/engine assignment                    |
| *                       | * | * | * | * | * | * | * | * | * | Fuel-injection pump                       |

## FLASHING-CODE EVALUATION

Connect socket 3 of evaluation unit for flashing-code diagnosis KDAW 9980 to a fused positive lead.

Connect socket 4 to socket 1 of evaluation unit.

Connect socket 2 to socket 4 of diagnosis socket.

Start engine.

Actuate nonlocking switch (evaluation unit) for between 2 and 4 seconds.

Then keep nonlocking switch pressed.

Flashing code of corresponding faulty component is indicated.

Repeat flashing-code evaluation:

Briefly disconnect plug connection (socket 4, diagnosis socket).

Press nonlocking switch.

Scan flashing code.

## SELF-DIAGNOSIS TEST PROGRAM

-Engine 602.961

Breakdown of ELR self-diagnosis  
(flashing code)

1 x All functions O.K.

2 x Engine-speed sensor

3 x Coolant temperature sensor

6 x Idle-speed-regulation closed  
loop (ELR)\*

\* Only short-circuit faults are detected

-Engine 603. Perform component test in same  
sequence.

Test conditions:

-Coolant temperature 60...80°C

- Over-voltage-protection fuse O.K.

- Mechanical transmission:

Battery voltage min. 11.5 V between socket 1  
and 5 of over-voltage protection.

- Automatic transmission:

Battery voltage min. 11.5 V. Selector lever  
in position "P".

- A/C off

- All plug connections made.

Idle speed:

| Engine  | Regulated<br>min <sup>-1</sup> | Unregulated<br>min <sup>-1</sup> |
|---------|--------------------------------|----------------------------------|
| 602.961 | 660...700                      | 580...660                        |
| 603.960 | 610...650                      | 530...610                        |
| 603.963 | 660...700                      | 530...610                        |

# SELF-DIAGNOSIS TEST PROGRAM ( 1 )

Flashing code "2"

Component: Engine-speed sensor  
In engine compartment next to battery

## Test 1: Ground connection

Detach multiple butt connector from engine-speed sensor.  
Connect ohmmeter with commercially available test prods to one wiring post in each case and ground.

Set value:  $> 1 \text{ M } \Omega$

Set value attained?

Engine-speed sensor defective,  
renew.

## Test 2: Internal resistance

Detach multiple butt connector from engine-speed sensor.

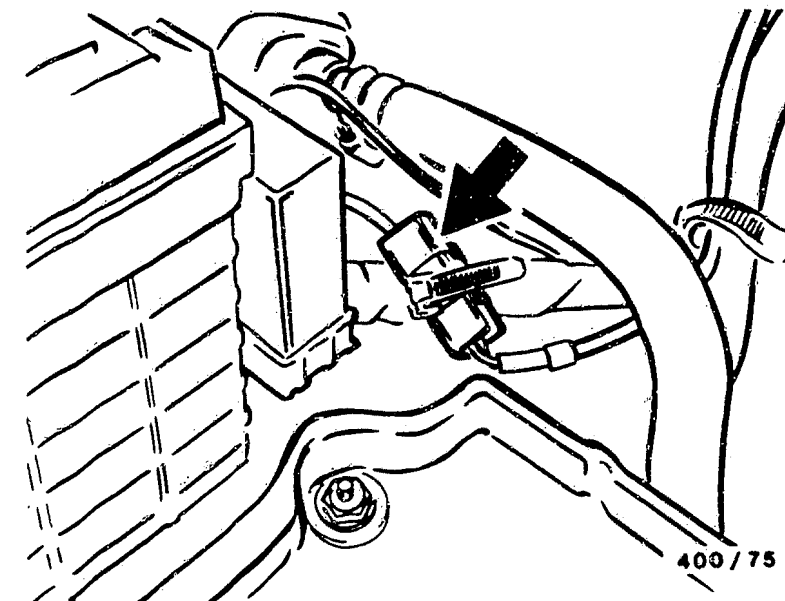
Connect ohmmeter to pins of multiple butt connector.

Set value:  $1.7 \dots 2.1 \text{ K } \Omega$

Set value outside tolerance

Engine-speed sensor defective,  
renew.

Continued on next picture page



SELF-DIAGNOSIS TEST PROGRAM ( 1 ) (CONTINUED 1)

Test 3:

Check to see whether engine-speed sensor is dirty.

N>

Detach multiple butt connector from engine-speed sensor.  
Connect test lead to both wiring posts.

Allow engine to idle.

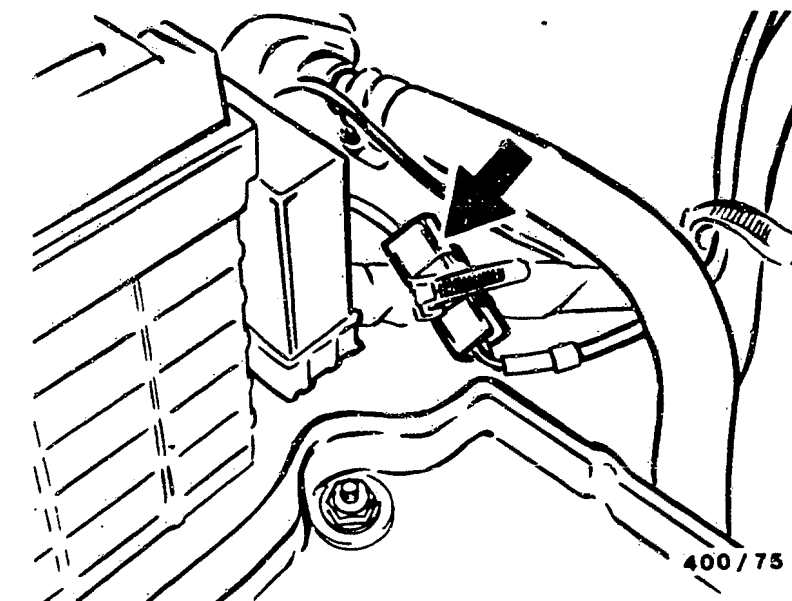
Set value : > 4 V AC

Note:

Voltage increases with increasing engine speed.

Is set value attained?

Check to see whether dirt has accumulated on engine-speed sensor and clean if necessary.  
Eliminate open-circuit in lead.  
Renew control unit.



Continued on next picture page

N17

<=>

N18

<=>

# SELF-DIAGNOSIS TEST PROGRAM ( 2 )

Flashing code "3"  
Component: Water temperature sensor

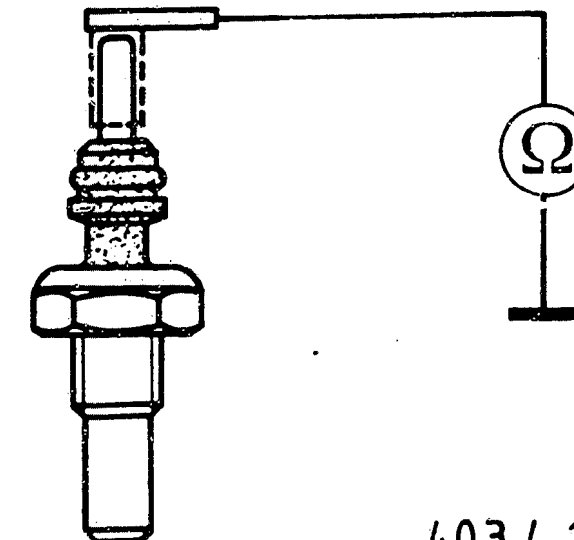
N>

Water temperature sensor defective,  
renew.

Test 1: Resistance  
Engine switched off. Detach  
connector at temperature sensor.  
Test ohmmeter with test lead with  
respect to ground (top picture).

See diagram for set values.

Set value at:  
+ 20 °C = 2200...2800 Ω  
+ 80 °C = 290...370 Ω



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Test 2: Voltage supply.

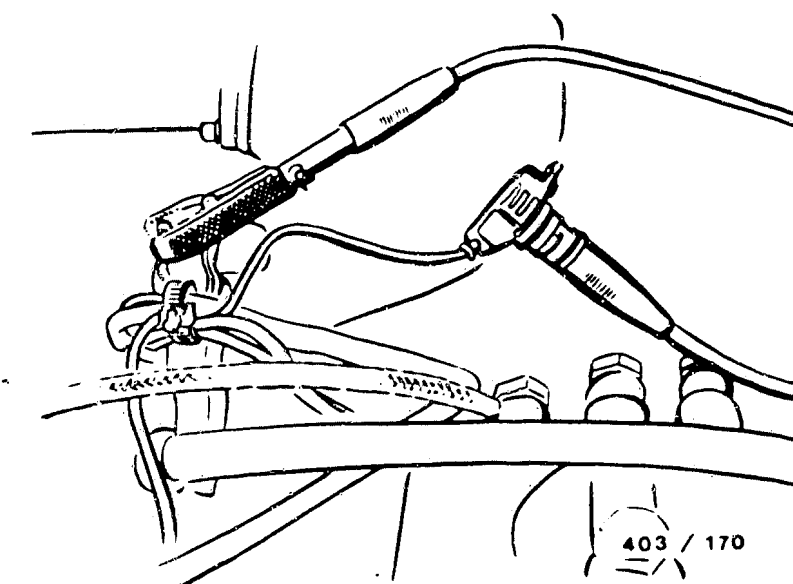
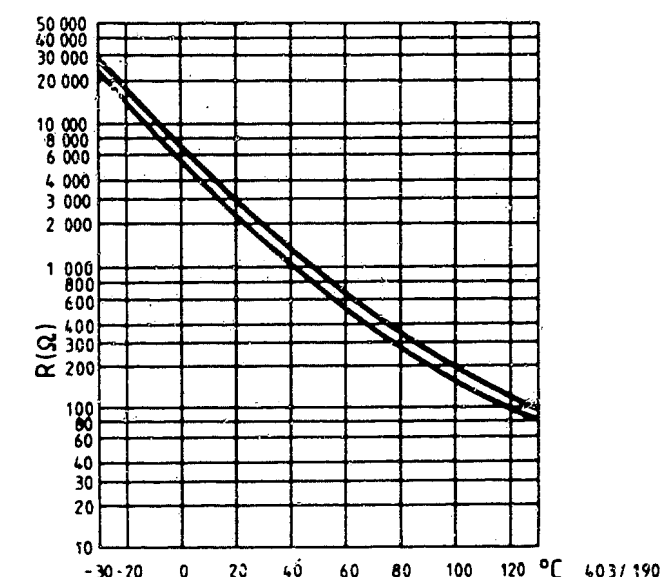
N>

Test for open-circuit in connector  
of water temperature sensor.

Detach connector at water  
temperature sensor.  
Connect voltmeter with commercially  
available test lead to 1-pole plug.  
Switch on ignition.

Set value approx. 5 V

Is set value attained?



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# SELF-DIAGNOSIS TEST PROGRAM ( 3 )

Flashing code: "6"

Component: Test idle-speed regulation (ELR)

Engine idling.

Regulated idle speed

Set values:

Engine 602.961: 660...700 min <sup>-1</sup>

Engine 603.960: 610...650 min <sup>-1</sup>

Engine 603.963: 660...700 min <sup>-1</sup>

Detach plug at servo magnet for at least 3 seconds.

On re-connection, idle speed briefly increases to in excess of regulated idle speed.

Does idle speed increase?

N>

## 1st test step

1. Detach plug at servo magnet; apply (see picture) 12 V for brief period (max. 3 seconds as otherwise servo magnet defective).

If there is no increase in idle speed:

Servo magnet defective - renew

Pay attention to shims when removing and installing.

## 2nd test step

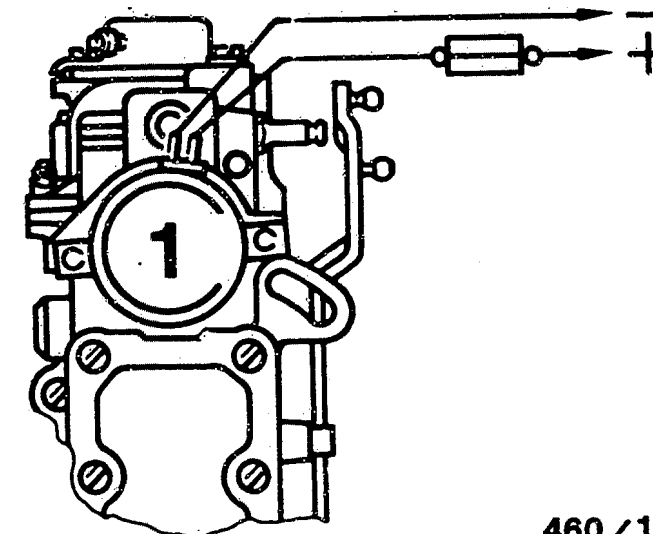
1. Engine switched off.

Use voltmeter to establish whether approx. battery voltage is being applied at both contacts of fuse at over-voltage protection.

Renew defective fuse.

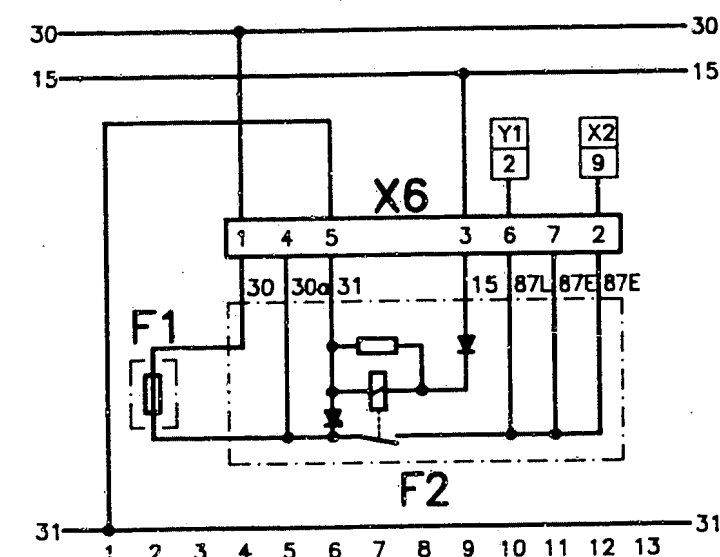
2. Test for open-circuit in lead of engine multiple butt connector term. 30, plug-connection lead, engine compartment socket 1 and battery ground lead with respect to over-voltage protection term. 1, 5 and 3 in each case.

3. Test for open-circuit in lead from over-voltage protection term. 6 to servo magnet. Eliminate open-circuit.



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X6 = Plug connection  
F1 = Central electrics console  
F2 = Over-voltage protection



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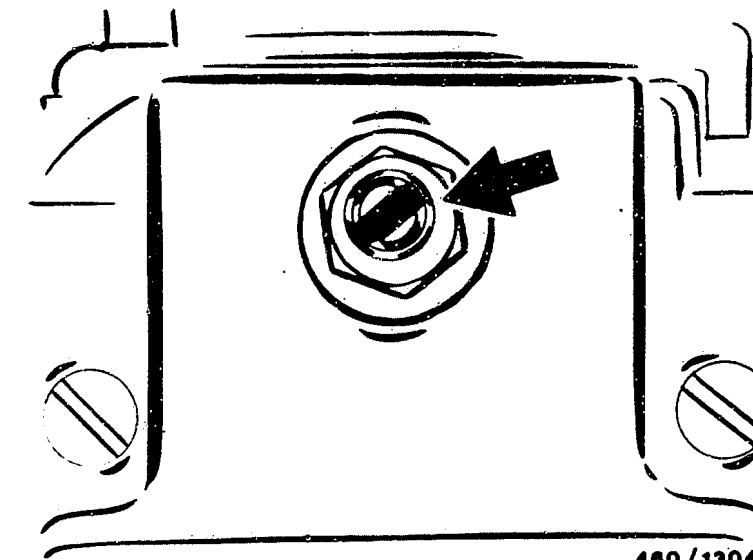
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4. Detach ELR control unit.  
Test for open-circuit in leads from control-unit base term. 11 to battery ground, from term. 8 to coolant temperature sensor, from term. 10 and 12 to engine-speed sensor and from term. 9 to over-voltage protection term. 2.  
Eliminate open-circuit.

3rd test step

Attach control unit.  
Engine idling.  
Detach plug of servo magnet and test voltage at plug.  
Set value: approx. 12 volts  
If voltage is not attained

Renew ELR control unit



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Test unregulated idle speed.  
Plug at servo magnet detached.  
Set values:  
Engine 602.961: 580...660 min <sup>-1</sup>  
Engine 603.960: 530...610 min <sup>-1</sup>  
Engine 603.963: 530...610 min <sup>-1</sup>  
Idle speed O.K.

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Loosen lock nut and adjust idle speed at idle-speed adjusting screw (arrow)